CAPITA | AECOM

Water and Environment Management Framework
Lot 3 – Engineering and Related Services

West Wight Coastal Flood and Erosion Risk Management Strategy

Appendix F – Economic Appraisal Report

March 2017

CAPITA | AECOM

Document overview

Capita | AECOM was commissioned by the Isle of Wight Council in October 2014 to undertake a Coastal Flood and Erosion Risk Management Strategy. As part of this commission, an economic appraisal is required in order to inform the selection of preferred management options.

Document history

Version	Status	Issue date	Prepared by	Reviewed by	Approved by
1	Draft for comment	September 2015	George Batt – Graduate Coastal Engineer	Jon Short Senior Coastal Specialist	David Dales Director (Water)
2	Draft following client comments	December 2015	George Batt - Graduate Coastal Engineer Ben Taylor - Graduate Coastal Engineer	Jon Short Senior Coastal Specialist	David Dales Director (Water)
3	Draft following board meeting	February 2016	Ben Taylor – Assistant Coastal Engineer	Jon Short Senior Coastal Specialist	David Dales Director (Water)
4	Update for Consultation	March 2016	Ben Taylor Assistant Coastal Engineer	Jon Short Principal consultant	David Dales Director (Water)
5	LPRG submission	November 2016 (& update Jan 2017)	George Batt – Graduate Coastal Engineer	Ben Taylor Assistant Coastal Engineer	Jon Short Principal consultant & IWC
6	Updates following LPRG review	January 2017	George Batt – Graduate Coastal Engineer & IWC	Ben Taylor Assistant Coastal Engineer & IWC	Jon Short Principal consultant & IWC
7	Final. Updates following 2nd LPRG review	March 2017	George Batt – Graduate Coastal Engineer & IWC	Ben Taylor Assistant Coastal Engineer & IWC	Jon Short Principal consultant & IWC

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1. Introduction

1.1 Project Background

Capita | AECOM has been appointed by the Isle of Wight Council (IWC) to develop a coastal flood and erosion risk management strategy ('the Strategy') for West Wight, between Freshwater Bay westward along the coast to East Cowes. As part of the development of the Strategy Capita | AECOM undertook an economic appraisal of strategy options. This formed a key part of the Strategy development process and helped inform the selection of preferred management options. This report outlines the procedure and outcomes of the economic appraisal.

1.2 Economic Appraisal

The aim of an economic appraisal, within a coastal strategy, is to determine whether coastal management options are worthwhile and to ensure that the most efficient allocation of resources is achieved.

To do this, the economic appraisal undertaken in this study compared the costs of particular coastal management options to the benefits arising from these options. Costs have been estimated associated with coastal management options include constructing and maintaining coastal defence structures, installing property level protection, providing flood adaption/warnings or temporary flood barriers. Costs are compared against the benefits arising from constructing these options which are referred to as flood and erosion damages (to people, assets, infrastructure and the environment).

This comparison is known as a cost-benefit analysis (CBA) and provides a rational and systematic framework for assessing the advantages and disadvantages of alternative options. This is achieved by expressing all of the potential costs and benefits of an activity in a directly comparable unit of measurement; in monetary terms. By doing so, the costs and benefits of different options can be directly compared and treated in the same manner during the analysis. In economic terms, the most efficient option is defined as that which provides the greatest level of well-being for society as a whole. An option is considered to be 'justified' if the benefits outweigh the costs.

The cost-benefit appraisal of options in the Strategy was carried out using the framework of the HM Treasury and Environment Agency Flood and Coastal Erosion Risk Management appraisal guidance (FCERM-AG, 2010). FCERM-AG represents the latest standard of cost-benefit analysis for all flood and coastal risk projects in England.

An integral part of CBA is the baseline option of 'do nothing'. The 'do nothing' baseline represents an assumed situation where no action is taken to manage flood and erosion risks. This hypothetical 'walkaway' scenario is essential to CBA as it provides the baseline from which all other options and scenarios can be compared against in order to demonstrate the economic benefit of doing something.

2. Strategic Approach

The economic assessment is part of the strategy development process. This section introduces the key concepts of the 'option development' process so that the role of the economic assessment can be understood.

2.1 Strategy Development

A key aim of the Strategy is to provide sustainable and robust options for the management of coastal flood and erosion risk along the Strategy frontage. Each option should outline what measures are required over the next 100 years and consider local needs and opportunities, yet also provide robust solutions over a wider area in line with strategy level thinking.

2.1.1 Option Appraisal Period

The Strategy options were appraised over 3 time periods (often referred to as epochs):

- Short term (2015 – 2025)
- Medium term (2025 – 2055)
- Long term (2055 – 2115)

Ideally these time periods should align with the SMP (Shoreline Management Policy) so that management policy changes can be supported by strategic options. The approved Isle of Wight SMP2 (2011) set policies for the epochs 2005 – 2025, 2025 – 2055, then 2055 – 2105.

If this Strategy was to align exactly with the SMP epochs it would mean the Strategy appraisal period would be only 90 years (10 years short of the typical FCERM appraisal period of 100 years).

The Strategy sets preferred options over a 100 year appraisal period from the present day (2015) to 2115. Therefore the first option appraisal period has been shortened in The Strategy from the typical 20 year guidance period to 10 years (so that the timing aligns with the SMP first epoch). The medium term runs for an additional 30 years (as per the SMP epoch 2) and the last epoch runs for 60 years to deliver a 100 year Strategy appraisal period. This means the Strategy period runs for 10 years beyond the SMP life, but this is deemed acceptable given the level of future uncertainty and the likelihood that the long term SMP policies would remain consistent beyond 2105. These appraisal periods were selected and agreed with the Project Steering Group early in the project.

2.2 Strategy Management Zones

Strategy Management Zones (SMZs) have been developed to facilitate appraisal of strategy options. This strategic approach was required to prevent disjointed and inconsistent decision making across the Strategy frontage. The approach also helped to ensure that future actions provide holistic, sustainable and cost effective solutions for the Strategy coastline.

In total, six SMZs were established for the Strategy frontage (
Figure 2-1). These are defined below:

SMZ 1. **Needles Headland** - Fort Redoubt to southern limit of Totland Bay

SMZ 2. **Totland and Colwell Bays** – Southern limit of Totland Bay to Fort Victoria

SMZ 3. **Yarmouth and the Western Yar** – Yarmouth coast (Fort Victoria to Port la Salle) and the Western Yar valley (including Freshwater Bay)

SMZ 4. **Newtown Coast** – Bouldnor cliff to Thorness Bay (including Newtown Estuary)

SMZ 5. **Gurnard and Cowes Headland** – Gurnard Luck to Cowes Parade

SMZ 6. **Cowes, East Cowes and the Medina** – Cowes Parade to Old Castle Point, East Cowes

Strategy Management Zones 3, 5 and 6 were broken down further into sub zones to facilitate a more robust option appraisal process in these areas. These sub-zones are defined below:

SMZ 3a. Yarmouth coast (Yarmouth town, and Fort Victoria to Port la Salle)

SMZ 3b. Western Yar Estuary (Yar Estuary shoreline including Thorley Brook and Barnfields Stream)

SMZ 3c. Freshwater (Freshwater Bay, Freshwater village and the Causeway)

SMZ 5a. Gurnard Luck and Gurnard cliff (Gurnard Luck / Gurnard Marsh area)

SMZ 5b. Gurnard to Cowes Parade (Cowes headland, from Gurnard Bay to Cowes Parade)

SMZ 6a. Cowes and East Cowes (Cowes: Cowes Parade to Medina Wharf. East Cowes: Shrape Breakwater to Kingston Road Power Station)

SMZ 6b. Medina Estuary and East Cowes Outer Esplanade (Medina Wharf and Kingston Road Power Station south to Newport Harbour and Shrape Breakwater to Old Castle Point)

SMZ 6c. Newport Harbour (Newport Harbour and quayside)

The geographic boundaries and the common themes or issues describing each SMZ are provided in Table 2-1.

2.3 Option Development Units

To ensure that the management solutions proposed by the Strategy are robust and sustainable at the local level it was necessary to split the SMZ frontages into smaller Option Development Units (ODUs). This step helps accommodate the local scale variations in present day land use, future land use (redevelopment), land ownership, coastal defence asset types and coastal flood and erosion risk management that exist within each SMZ. In essence, the creation of the ODUs provides the flexibility to refine strategic options that are both appropriate on a local scale and also fit within the FCERM-AG criteria.

Option Development units are defined as manageable areas with consistent themes that help to facilitate and rationalise option identification and appraisal. The following information was used to define the ODU boundaries:

- Isle of Wight Shoreline Management Plan 2 (2011) boundaries and policies;

- Current coastal risk management assets and standards of protection;
- Coastal processes;
- Flood zones and mapping;
- SMP erosion bands;
- Land use and ownership;
- Opportunities and constraints; and
- Historical and current issues or concerns.

In total 32 ODUs were created along the Strategy frontage.
Figure 2-1 presents the location of the SMZs and ODUs along the frontage. Figure 2-2 presents the location of the SMZ sub-zones.

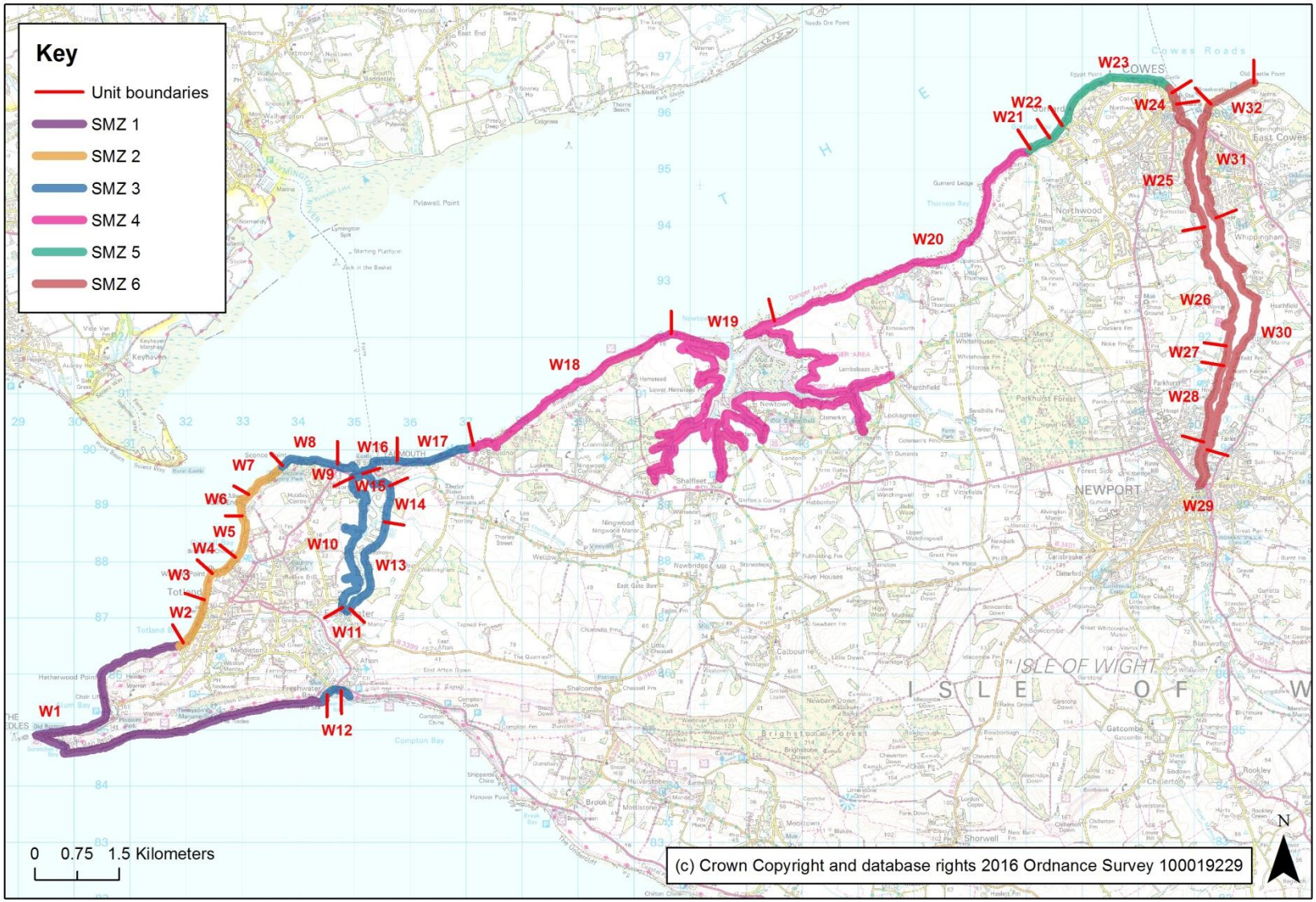

Figure 2-1: SMZ and ODU locations and boundaries within the Strategy frontage

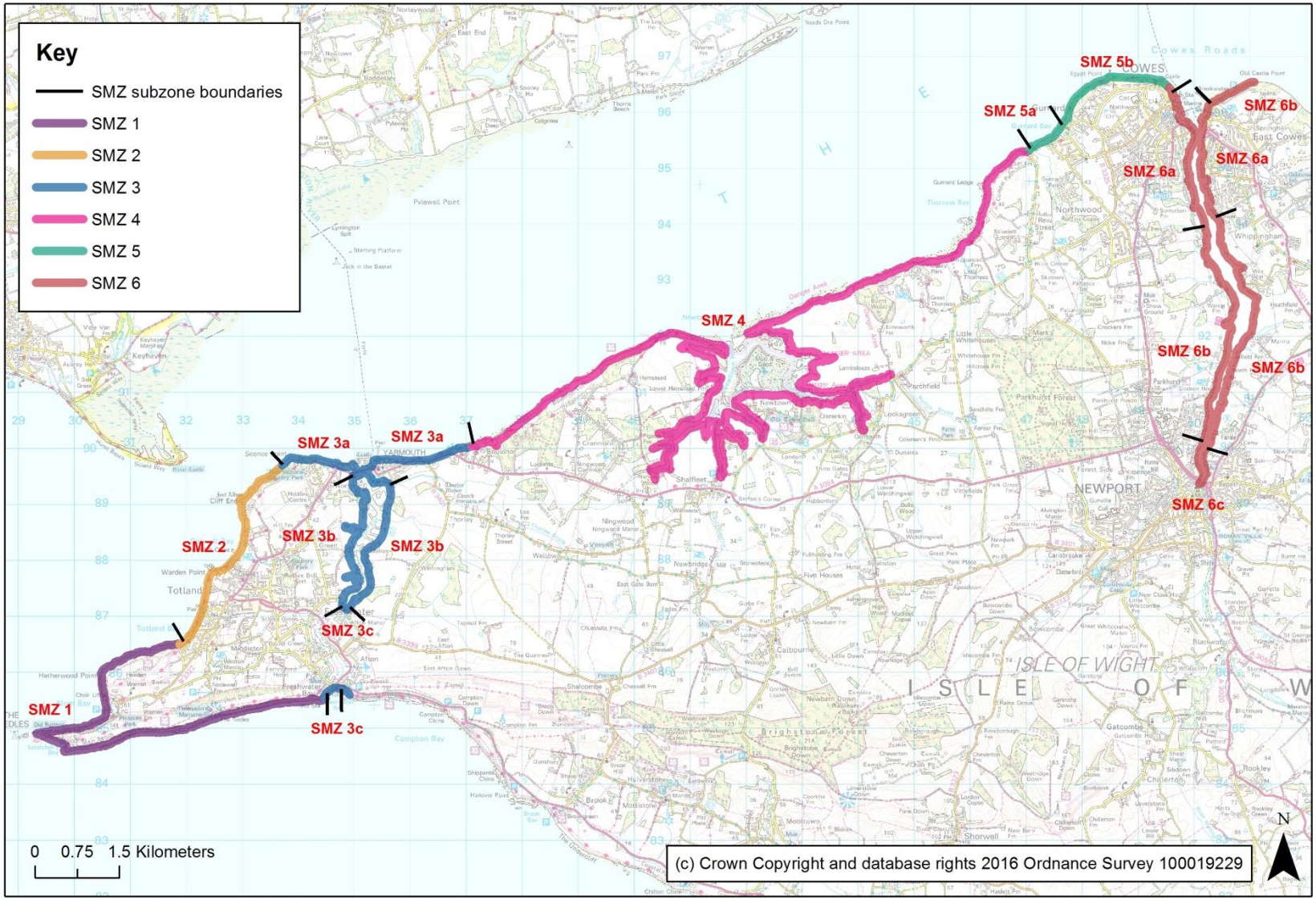

Figure 2-2: SMZ sub-boundary locations within the Strategy frontage

Table 2-1: Overview of Strategy Management Zone themes and characteristics

Management Zone Summary					
Zone	Name	Geographic Extent	Option Development Units	SMP Policy (2011)	Zone Characteristics (common themes / issues)
1	Needles headland	Fort Redoubt to southern limit of Totland Bay	W1	No Active Intervention	• Undefended, cliffed coastline • Exposed to relatively large waves – high rates of erosion • Small number of assets at risk from erosion at the clifftop • No flood risk Leisure / recreational use
2	Totland and Colwell bays	Southern limit of Totland Bay to Fort Victoria	W2 to W7	Mixed (Hold the Line in the south. Transferring from Hold the Line to No Active Intervention in the north)	• Cliffs subject to landsliding • Significant number of residential and some commercial properties at risk of erosion • Popular recreational area No flood risk
3a	Yarmouth Coast	Yarmouth town and Fort Victoria to Port la Salle	W8 to W9 and W15 to W17	Mixed (Hold the Line around Yarmouth and to the east. Transferring from Hold the Line to No Active Intervention in the west)	• Yarmouth is a key residential and town centre • Significant flood and erosion risks • Roads that provide access to other parts of the Island are at risk from flooding and erosion Ferry terminal provides link to mainland
3b	Western Yar Estuary	Western Yar Estuary shoreline including Thorley Brook and Barnfields Stream	W10, W13 and W14	No Active Intervention, with Managed Realignment at Thorley Brook	• Recreation area and farmland • Cyclepath situated on the eastern side of the estuary • Predominantly undefended • Small and localised flood and erosion risks Mostly sheltered and estuarine

Management Zone Summary					
Zone	Name	Geographic Extent	Option Development Units	SMP Policy (2011)	Zone Characteristics (common themes / issues)
3c	Freshwater	Freshwater Bay, Freshwater Village and the Causeway	W11 and W12	Hold The Line	• Large number of residential and commercial properties at risk from flooding • Low lying area at flood risk between the Causeway and Freshwater Bay • Freshwater Bay exposed to large swell waves that can result in overtopping of the defences • Small risk of erosion at Freshwater Bay A3055 at risk of flooding
4	Newtown Coast	Bouldnor cliff to Thorness Bay, including Newtown Estuary	W18 to W20	No Active Intervention	• Open space • Undefended • Environmentally important area • Small localised risk of erosion No flood risk
5a	Gurnard Luck and Gurnard cliff	Gurnard Luck / Gurnard marsh area	W21 to W22	Mixed (Hold the Line changing to No Active Intervention at Gurnard Luck. No Active Intervention to the east)	• Significant risk of flooding at Gurnard Luck • Erosion risk because of the close proximately of properties to the coastline • Existing private defences have relatively low crest levels
5b	Gurnard to Cowes Parade	Cowes headland, from Gurnard Bay to Cowes Parade	W23	Hold The Line	• The developed coastal slopes have potential for landslide reactivation • Erosion is more of a significant risk than flooding There are existing sea wall defences, overtopped at low points at high tide events
6a	Cowes and East Cowes	Cowes: Cowes Parade to Medina Wharf. East Cowes: Shrape breakwater to	W24 to W25 and W31	Hold The Line	• Cowes and East Cowes are key urban centres • Significant amount of residential and commercial properties are at risk from both flooding and erosion • Waterfront access is important

Management Zone Summary					
Zone	Name	Geographic Extent	Option Development Units	SMP Policy (2011)	Zone Characteristics (common themes / issues)
		Kingston Road Power Station			Two ferry terminals provide links to the mainland
6b	Medina Estuary (and East Cowes Outer Esplanade)	Medina Wharf and Kingston Road Power Station south to Newport Harbour and Shrape Breakwater to Old Castle Point	W26 to W28, W30, W32	Mixed (mainly No Active Intervention, plus Hold the Line at West Medina Mills and Hold the Line transferring to No Active Intervention at East Cowes outer esplanade)	• Land is predominantly farmland and recreational land • Small landslides have blocked access near Old Castle Point • Small amount of properties at risk from flooding and erosion
6c	Newport Harbour	Newport Harbour and quayside	W29	Hold The Line	• Waterfront access is important • Commercial and industrial properties are close to the waterfront and at risk of flooding • If the harbour walls failed a number of properties are at risk of damage

3. Estimating 'Do Nothing' Damages

3.1 Overview of the methodology for estimating flood and erosion damages

Following the division of the Strategy area into the Strategy Management Zones and Option Development Units the initial part of the economic assessment was to estimate the 'Do Nothing' damages resulting from flooding and erosion. This provides the baseline against which to compare the economic benefits of the 'Do Something' options being appraised.

Inspection of the flood modelling results and the Isle of Wight erosion predictions in GIS allowed the baseline 'Do Nothing' flood and erosion risk to be established for each SMZ.

To identify individual properties at risk, Isle of Wight Council provided an address point dataset (National Receptor Database, 2011) which included the property address, post code, property type and property coordinates for all residential assets within the strategy area. The property types were: detached, semi-detached, terrace and flat. An extra property type was added, 'beachside chalets', to account for properties in SMZ5 that were listed as detached when they were actually far smaller in size than the average detached house. The database was checked to remove duplicate address points, classify unknown property types and also to rationalise the number of flats counted in the assessment. For example, where single locations had multiple residencies on several floors, these were reduced to include only ground floor flats.

Flood depths for each individual property were obtained by conducting a point inspection in GIS. The depths were determined using the property location and the flood modelling for each scenario modelled. This was based upon LiDAR data rather than threshold survey data given the strategic nature of the project. No basement areas have been allowed for in the economic analysis, therefore flood damages were only counted for flood depths greater than the property level.

Using GIS the assets at risk of erosion within each erosion band were identified (if any part of the asset or building fell within a band it was counted) and written off in the economics at the appropriate discount rate. Where properties were at risk of both coastal erosion and flooding, PV flood damages were accrued up to the year of erosion write-off, at which point the property was removed from the flood damage appraisal.

The value of each residential property was required to consider potential write-off within the economic analysis. Average house sale prices over the past year were obtained based on Land Registry data. The data was averaged by post code region (e.g. PO31) for each property type. These were then applied to each property in the appraisal, for the purpose of write-off and capping.

A more detailed explanation of the derivation of flood and erosion damages is provided in the subsequent sub-sections.

3.2 Estimating 'Do Nothing' flood damages

3.2.1 Estimating Flood Depths and Extents

The 'Do Nothing' flood depths were determined through hydrodynamic modelling. The TuFlow hydrodynamic modelling software was used to simulate the 'Do Nothing' flood levels in four periods in time: 2015, 2025, 2055 and 2115.

The model simulations included the latest estimated extreme water levels for four locations within the strategy area (Freshwater Bay, Yarmouth, Gurnard and Cowes) and these were corrected for future sea level rise changes through the 100 year appraisal period (see Strategy Appendix C – Coastal Processes Review). Wave overtopping was also applied where required (See Appendix D – Flood Modelling and Risk Mapping). Table 3-1 to Table 3-4 below outline the extreme water level scenarios used in modelling simulations.

Table 3-1: Existing and predicted future extreme water levels (mOD) for Freshwater Bay

Freshwater Bay	Medium Emissions Scenario 95% + Storm Surge			
	Extreme Water Level (mOD)			
Return Period (years)	2015	2025	2055	2115
1	1.47	1.53	1.73	2.25
2	1.55	1.61	1.81	2.34
5	1.64	1.70	1.91	2.45
10	1.72	1.78	1.99	2.54
20	1.78	1.84	2.06	2.61
50	1.87	1.93	2.16	2.72
75	1.90	1.96	2.19	2.76
100	1.92	1.98	2.21	2.78
200	1.98	2.04	2.28	2.85
500	2.06	2.13	2.36	2.95
1000	2.11	2.18	2.42	3.01

Table 3-2: Existing and predicted future extreme water levels (mOD) for Yarmouth

Yarmouth	Medium Emissions Scenario 95% + Storm Surge			
	Extreme Water Level (mOD)			
Return Period (years)	2015	2025	2055	2115
1	1.83	1.89	2.09	2.61
2	1.91	1.97	2.17	2.70
5	2.01	2.07	2.28	2.82
10	2.08	2.14	2.35	2.90
20	2.15	2.21	2.43	2.98
50	2.24	2.30	2.53	3.09
75	2.27	2.33	2.56	3.13
100	2.29	2.35	2.58	3.15
200	2.35	2.41	2.65	3.22
500	2.44	2.51	2.74	3.33
1000	2.49	2.56	2.80	3.39

Table 3-3: Existing and predicted future extreme water levels (mOD) for Gurnard

Gurnard	Medium Emissions Scenario 95% + Storm Surge			
	Extreme Water Level (mOD)			
Return Period (years)	2015	2025	2055	2115
1	2.35	2.41	2.61	3.13
2	2.43	2.49	2.69	3.22
5	2.53	2.59	2.80	3.34
10	2.60	2.66	2.87	3.42
20	2.67	2.73	2.95	3.50
50	2.76	2.82	3.05	3.61
75	2.79	2.85	3.08	3.65
100	2.82	2.88	3.11	3.68
200	2.88	2.94	3.17	3.75
500	2.97	3.04	3.27	3.86
1000	3.03	3.10	3.34	3.93

Table 3-4: Existing and predicted future extreme water levels (mOD) for Cowes

Cowes	Medium Emissions Scenario 95% + Storm Surge			
	Extreme Water Level (mOD)			
Return Period (years)	2015	2025	2055	2115
1	2.45	2.51	2.71	3.23
2	2.53	2.59	2.79	3.32
5	2.63	2.69	2.90	3.44
10	2.70	2.76	2.97	3.52
20	2.77	2.83	3.05	3.60
50	2.86	2.92	3.14	3.70
75	2.89	2.95	3.18	3.74
100	2.92	2.98	3.21	3.78
200	2.99	3.05	3.28	3.86
500	3.08	3.15	3.38	3.96
1000	3.14	3.21	3.44	4.03

The flood model results were output to GIS to facilitate the inspection flood depths for assets within the National Receptor Database (2011) within the flood areas for the range of return periods. This allowed flood depths to be attributed to each property receptor for the range of return periods being modelled.

3.2.2 Residential Flood Depth Damages – asset damage

Flood damages were obtained from the Multi-Coloured Manual (MCM) (Penning-Rowsell 2013), updated to January 2015 prices using the Consumer Prices Index (Table 3-5). The value of flood damage was based on the residential property type (detached, semi, terrace, flat etc) and the depth of flooding for each property for each flood scenario. Values for 'Short Duration, salt water, major flood, sewage' were adjusted by a factor of 1.056 to allow for the emergency costs that can be justified as real economic costs, not counted elsewhere in the benefit assessments as recommended in the MCM. The beachside chalets in SMZ 5a were given the same depth dependent flood damages as bungalows.

A range of non-asset related damages (intangibles) were also included in the assessment – for more information see Section 3.4.

Table 3-5: Flood damages adopted from the MCM (2013). Values adjusted to account for emergency uplift and January 2015 (latest available) Consumer Price Index

Short Duration, salt water, major flood, sewage, January 2015. Adopted from MCM (2013)																	
Index	**MCM Code**	**Property Type**	**Component**	**0**	**0.05**	**0.1**	**0.2**	**0.3**	**0.6**	**0.9**	**1.2**	**1.5**	**1.8**	**2.1**	**2.4**	**2.7**	**3**
2	11	Detached	Total Damage	992	9462	15836	27368	33723	40292	44262	48780	53430	58579	62796	66426	74539	78686
3	12	Semi-detached	Total Damage	1327	6667	10726	18159	22137	26734	28949	31874	34628	37834	40768	43685	49539	52327
4	13	Terrace	Total Damage	1153	6176	9762	16676	20243	24639	26569	29067	31327	33917	36124	38352	43724	45967
5	14	Bungalow	Total Damage	926	10076	16263	26287	31616	38223	42293	46897	51680	57071	61605	65818	74157	78300
6	15	Flat	Total Damage	774	6454	10528	18013	21896	26816	28970	31216	33138	35332	37086	38448	43028	44867

3.2.3 *Commercial Flood Depth Damages – asset damage*

Commercial property damages were also obtained from Penning-Rowsell (2013) based on the commercial property type, the footprint area (m2) and the depth of flooding for each of the modelled water levels. Values for 'Short Duration, Yes Warning, No Cellar, salt water' were updated to January 2015 using the Consumer Price Index and then adjusted by a factor of 1.056 to allow for the emergency costs that can be justified as real economic costs, not counted elsewhere in benefit assessments as recommended in the Penning-Rowsell (2013).

Emergency accommodation costs and intangible health benefits are not applicable to commercial properties.

3.2.4 *Write-off and Capping Damages*

In accordance with FCERM-AG residential and commercial properties were defined as written off once flooded by an event of 1:3 year return period or less, as the property would be no longer habitable or functional. Once written off, these properties no longer accrue flooding or erosion damages. The guidance also requires that the property flood damages over the appraisal period must not exceed the property market value. The cumulative damages were monitored for each property and once they exceeded the property value further flood damages were capped and the property was written off.

3.2.5 *Discounting*

Discounting is a technique used to compare benefits (and costs) that occur at different points in time over the appraisal period (i.e. the next 100 years). Standard discount rates have been used to convert all cash damages to 'present value' (PV) terms, so that future sums of money can be represented by their current worth. This enables the whole life benefits (and costs) of each management option to be compared and also leads to a realistic assessment of the cost implications of each option in today's terms. According to FCERM-AG, the following variable discount rates have been used within the economic appraisal; 3.5% for the years 0 to 30, 3% for the years 31 to 75, and 2.5% for the years 76 to 99 resulting in a PV factor over 100 years at 29.9 (HM Treasury Green Book, 2003)

3.3 Estimating erosion damages

3.3.1 *Erosion Predictions*

The Isle of Wight Council provided erosion zones (updated in 2015) that were used to determine assets and properties at risk of erosion (coastal erosion and landsliding) under this scenario using the National Receptor Database (2011). Three zones were provided (2015-2025, 2025-2055 and 2055-2115.

3.3.2 *Identifying assets at risk*

Assets were included in the erosion risk bands if any part of the building fell within that erosion zone. This is because any property which is within the erosion risk bands would be at significant risk of immediate failure and would be uninhabitable. The properties in an erosion zone were assumed to erode in the middle year of the erosion zone i.e. any properties in the 2015-2025 zone were assumed to fail on 2020, and the discounted damages taken in this year. The last erosion zone of 60 years was split into two zones of 30 years so that the distribution and discounting of damages were more suitably represented over the Strategy period.

The OS Mastermap building outlines were used to assess the assets at risk by comparing their position in relation to the erosion zones.

Whilst the erosion zones did not cover Newport it has been considered that if the harbour walls failed under a 'Do Nothing' Scenario, a number of properties in close proximity would be expected to be at risk of loss. To reflect this in the 'Do Nothing' scenario any properties within 10m of the Newport harbour walls were assumed to fail/erode in the same year the wall is predicted to fail.

3.3.3 Cowes – Gurnard potential landslide reactivation zone

As well as erosion zone predictions to 2115, the Isle of Wight Council also identified an area at risk from potential landsliding based on previous geotechnical reports spanning from Gurnard to Cowes (Figure 3-1). Within this area, the current coastal defences prevent erosion of the toe of the coastal slopes, minimising the risk of landslide reactivation.

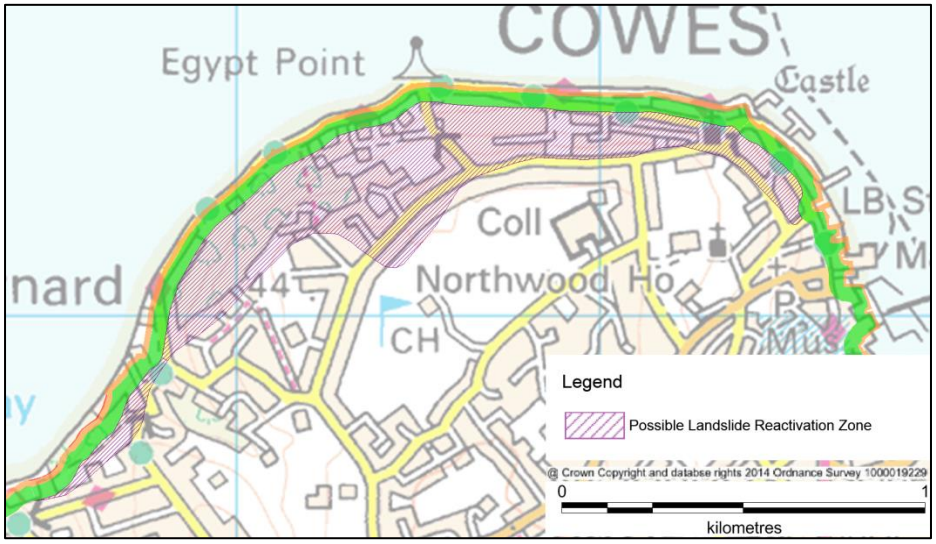

Figure 3-1: Location of Gurnard to Cowes reactivation zone

To estimate the potential damages from a landslide reactivation event in a 'Do Nothing' scenario it is assumed that the maximum assets 'at risk' of erosion through landslide event over the Strategy period would be 50% of the total assets. The total assets within the reactivation zone (excluding the assets in the shoreline erosion zones, which have already been included in the economics assessment) is £122million.

The residual life of the seawall fronting the reactivation zone is approximately 15 years, so therefore the potential landslip damages have been estimated to occur after year 15 of the appraisal period.

Once a landslip has occurred, it was assumed that there would be a linear increase in assets at risk; whereby in year 15 at the time of the landslip event, 0% of assets would be at risk, and that by year 100, 50% of the assets would be at risk. This equates to approximately 0.6% of the assets being lost each year, from year 15 to year 100.

The Present Value damage over the 100 year appraisal period is estimated to be £12.5 million. This is a value of £61 million in cash terms (non-discounted).

3.4 Indirect Flood and Erosion Damages

In addition to direct damages to commercial and residential property, indirect flood and erosion losses have been considered. Indirect flood and erosion losses reflect deviations from the economic theory that suggests that in a perfectly competitive world, all sales or production would simply transfer to a competitor with no financial loss to the nation as a whole. In reality, deviations from the competitive model exist and trade cannot simply be transferred, leading to indirect flood and erosion damages.

With regard to the Strategy, the transport infrastructure, visitor travel durations and safety of residents were identified as areas likely to benefit from improved flood and erosion protection.

Health

Intangible health benefits were included in the appraisal at a rate of £310 per residential property at risk of flooding (in accordance with the MCM, 2013 and corrected to January 2015 prices). Damage to vehicles affected by flooding were considered at a rate of £3,100 per vehicle (MCM, 2014). Of the residential and commercial properties at risk of flooding, 28% were considered to have vehicles at risk, with the remainder moved to higher ground or considered to not own a car.

During a flood event 50% of those at risk of flooding were considered to require temporary accommodation and food at a cost of £900 per property (with the remainder able to reside in upper floor accommodation).

Transport infrastructure disruption – flood

Flood modelling indicated two key roads would be at risk of tidal flooding. These two roads are the A3054 west of the Yar Bridge (SMZ3a) and the A3055 from Totland to Freshwater Bay (SMZ3c). Travel disruption damages during these events were calculated in accordance with MCM(2013) at a rate of £11.90/hour/car. The damages were based on the delay caused to road users, as there is no easily accessible diversion route – west of the Yarmouth to Freshwater Bay 'valley' is effectively cut-off, and the probability of flooding used to estimate an Annual Average Damage. Traffic count data provided by the Isle of Wight Council then enabled the average vehicles counts to be estimated (Table 3-6). Likely delay durations for various flood return periods were used in accordance with MCM (2013). The A3054 (Bouldnor Road) is expected to be at risk of erosion in year 40 under a 'Do Nothing' Scenario, so after this point no more flood damages are taken (see erosion losses below).

In SMZ3a there has been flooding in Yarmouth east of the Yar Bridge. However, the economic impact of this has not been assessed to avoid double counting of the vehicles travelling through both west and east of the Yar bridge. Vehicle counts were provided between Yarmouth and Shalfleet and Yarmouth and Totland so this approach removes the possibility of vehicles being counted twice.

Table 3-6: Road flooding damages

SMZ	Road	Average no. of vehicles per hour
3a	A3054 west of the Yar Bridge	147
3c	A3055 from Totland to Freshwater Bay	63

As well as flooding to roads, flooding of the N22 cyclepath between Freshwater and Yarmouth (SMZ3b) has also been considered. This cyclepath will flood with increased regularity over time and under a 'Do Nothing' scenario will become unusable for most people because of damage or debris preventing accessibility. The Isle of Wight Council provided usage data in 2015 that shows pedestrians use this path 31,500 times a year and cyclists 39,312 times a year. Value of loss were estimated to be £1 for cyclists (cost of a car journey between these locations is >£1) and £0.50 for pedestrians. It was assumed that the path would begin to become inaccessible after year 10 under 'Do Nothing' for half of the people currently using it (when the path is being flooded yearly in multiple places) and then throughout the Strategy period 50% of people currently using the path would no longer be able to use it.

Flooding of the three ferry terminals in the Strategy area has also been considered. To determine flood damages it was assumed that during a flood event, if the ferry terminal car parks were flooded, the terminal would not be operational. Closure durations of the terminal car parks were based on the MCM guidance for determining flood closures of roads based on return periods of events.

The damages of the ferry terminals being flooded was based on lost ticket revenues. An estimate of the hourly revenue of each of the three ferry terminals was made based upon data obtained on ticket prices and passenger numbers.

Over the duration of the 100 year appraisal period, for each ferry terminal, the Present Value damage associated with flooding was estimated as £1.9 million.

Transport infrastructure disruption – erosion

There are two important link roads in the study area that are predicted to be lost due to erosion under a 'Do Nothing' scenario. The A3054 between Yarmouth Common and Port la Salle (also known as the Bouldnor road) is expected to be at risk of erosion after the deterioration and failure of the seawall at the foot of the steep coastal embankment under the road from 15 years' time. As there is not feasible diversion route of sufficient capacity if this road were to fail in the 'Do Nothing' scenario the estimated damages would be the cost of rebuilding the road in a more setback location, £19.8million, discounted to year 15.

Another road at risk of erosion is the A3055 near Norton Spit west of the Yar Bridge which is expected to be at risk of erosion in year 40. The value of the road was estimated by using the price per m of the works to the road between Yarmouth Common and Port la Salle applied to this length. Again there is no feasible diversion if this road were to fail so an estimate of rebuilding the road in a more setback location was used – this cost was £6.9million discounted to year 40.

Erosion of the three ferry terminals in the Strategy area has also been considered. To estimate this indirect erosion damage, it was assumed that if the ferry terminals were eroded, there would be a six month period in which the buildings were rebuilt / moved to a different location. During this period, it was assumed that all revenue of the ferry terminals would be lost.

An estimate of the lost revenue of each of the three ferry terminals in the Strategy area over a six month period was made and based upon data obtained on ticket prices and passenger numbers. This was then discounted to the year when the terminals would be eroded (year 25).

A Present Value damage for each terminal of £3.5 million was determined for a six month closure period.

Visitor numbers

Isle of Wight is a popular tourist destination and it is expected that under a 'Do Nothing' scenario visitor numbers in certain areas would decline, mainly due to erosion causing a lack of accessibility.

Visit Isle of Wight (2014) estimate of the 4.3 million passengers making return trips across the Solent during the 2012/13 tourist year, 2.3m were visitors to the island. It was assumed that 30% of these visit the Strategy area (roughly 1/3 of the accessible island coastline is covered by the Strategy). Whilst in some areas like the Needles the eroding cliffs are actually an attraction, in other areas like Yarmouth a 'Do Nothing' policy would cause the main road to erode and therefore would result in travel diversions. It was assumed that visitors would continue to visit the Island, but damages would be accrued because of extra travel cost for visitors if they have to travel further for similar attractions or assets.

Calculation of damages caused by extra travel cost in a 'Do Nothing' scenario considered which areas visitors go to in the Strategy area and what year would damages begin in. In total, across the Strategy area, the Present Value damages associated with visitor numbers was estimated as £8.1M and this has been incorporated as part of the Do Nothing Damages.

Loss of life

The indirect damages associated with potential loss of life from a flood events have been estimated by following the Defra Flood and Coastal Defence appraisal guidance; Social Appraisal, Supplementary Notice to Operating Authorities – Assessing and Valuing the Risk to Life from Flooding for the Use in Appraisal of Risk Management Measures (2008).

By utilising this guidance and following the 'Risks to people' method, the loss of life (£) per magnitude of flood event was estimated. This calculation was based upon a number of variables for the appraisal area that included the flood hazard rating (variables include the depth and flow of water, and the debris factor), the area vulnerability rating (variables include a flood warning system, speed of flood onset and the nature of the area), and the people vulnerability rating (age of the population, health of the population).

The loss of life (£) for each magnitude of flood event was then factored by the probability of the flood event occurring to determine an annual damage per year associated with the loss of life. In total, across the Strategy area, the Present Value damages associated with loss of life was estimated as £6.5M and this has been incorporated as part of the Do Nothing Damages.

4. ‘Do Nothing’ damages

4.1 Residential properties at risk of flooding

Figure 4-1 to Figure 4-8 present a breakdown of the types of residential property that will be at risk from coastal flooding (1:200 year, 0.5% AEP event) over the next century within each Strategy Management Zone (SMZ) – any SMZs that do not have residential properties at risk of flooding in 2115 are not included, properties that are predicted to erode before 2115 have not been counted in these flooding figures.

No flood modelling was undertaken for SMZ 4 within the Strategy frontage as this area is largely undeveloped. However, based upon the latest Environment Agency flood zone mapping, in this area a total of 2 residential and 3 commercial properties are considered to be at risk from a 1:200 year flood event under present day conditions. Due to the unpopulated nature of this frontage the risk is not expected to increase in the future

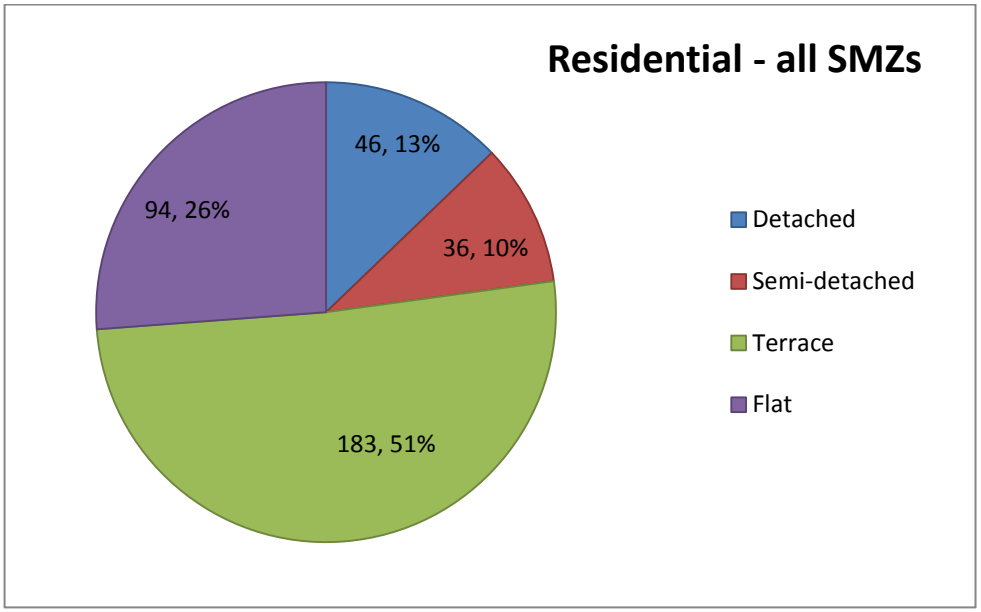

Figure 4-1: Types of residential properties at risk across the entire Strategy frontage (1:200yr event, 2115)

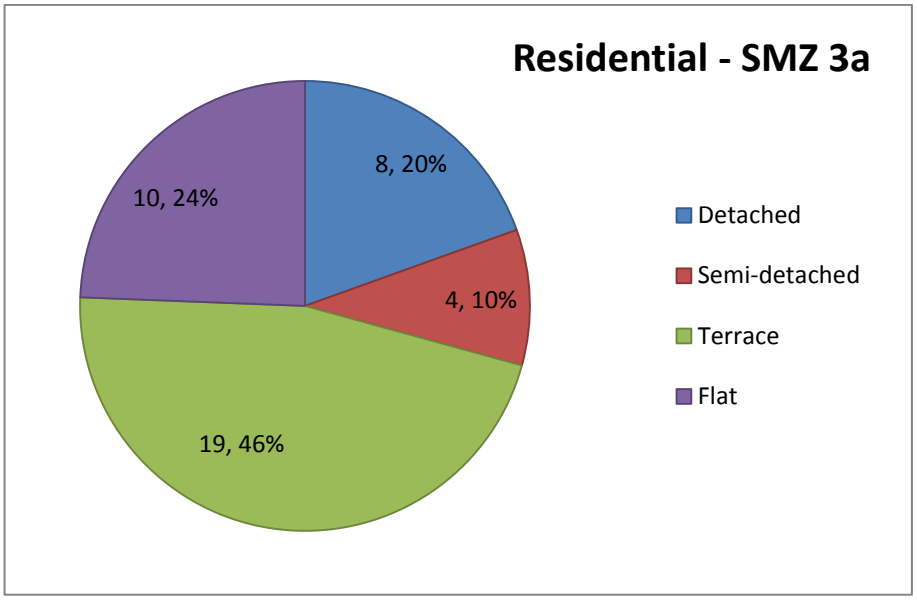

Figure 4-2: Types of residential properties at risk in SMZ 3a (1:200yr event, 2115)

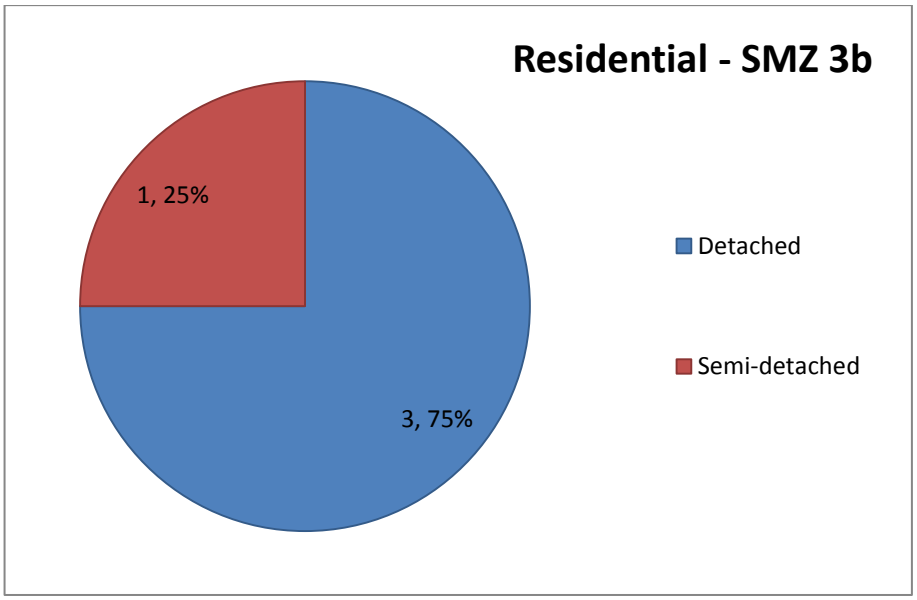

Figure 4-3: Types of residential properties at risk in SMZ 3b (1:200yr event, 2115)

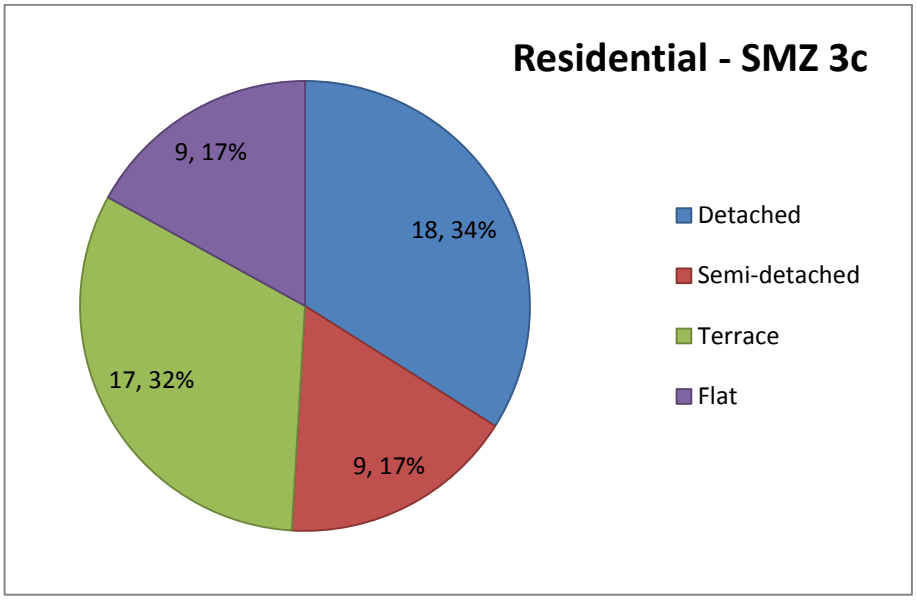

Figure 4-4: Types of residential properties at risk in SMZ 3c (1:200yr event, 2115)

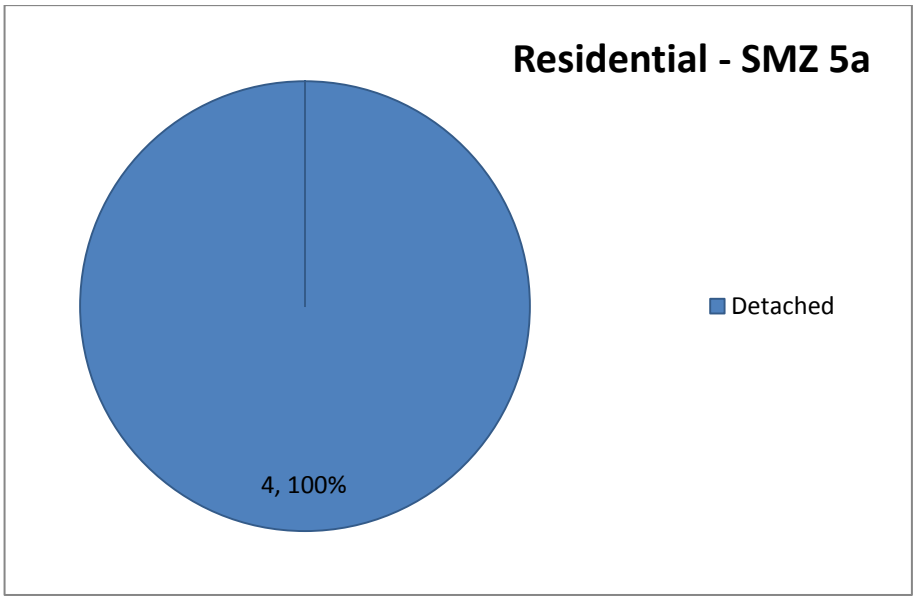

Figure 4-5: Types of residential properties at risk in SMZ 5a (1:200yr event, 2115)

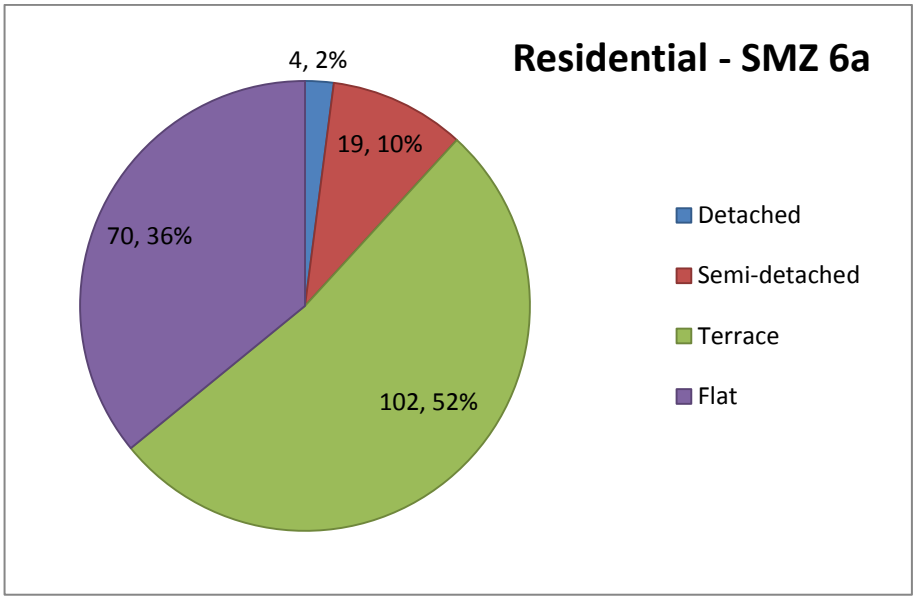

Figure 4-6: Types of residential properties at risk in SMZ 6a (1:200yr event, 2115)

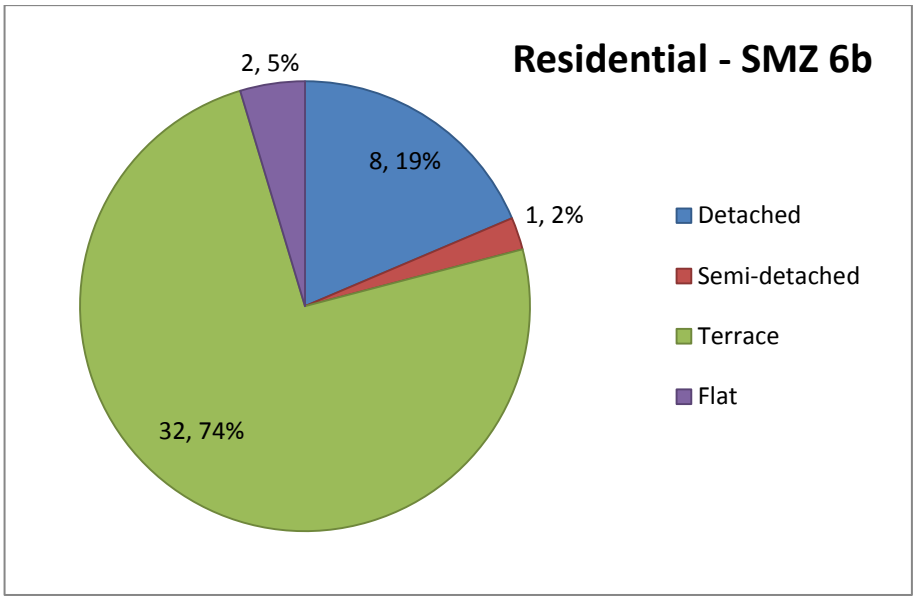

Figure 4-7: Types of residential properties at risk in SMZ 6b (1:200yr event, 2115)

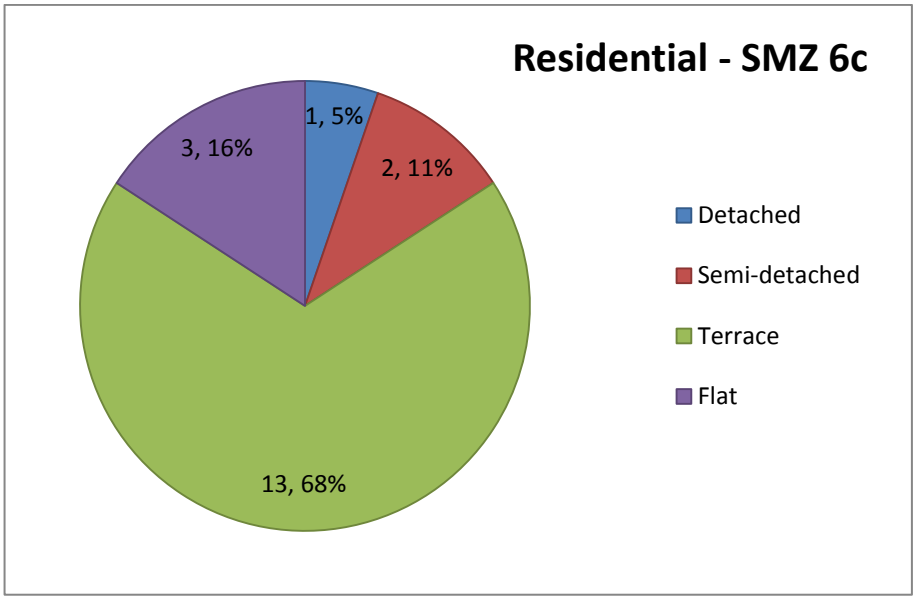

Figure 4-8: Types of residential properties at risk in SMZ 6c (1:200yr event, 2115)

4.2 Commercial Properties / Critical Infrastructure at risk of flooding

Isle of Wight Council provided a commercial address point dataset for the property address, post code, flood space (m2), type (e.g. commercial – office, commercial – warehouse) and property coordinates for all assets within the strategy area.

A broad range of commercial properties are found in the strategy area. Table 4-1 presents a summary of the types of commercial property at risk of flooding over the coming century in each SMZ from a 1:200 year event – any SMZs that do not have commercial properties at risk of flooding are not included, properties that are predicted to erode before 2115 have not been counted in these flooding figures.

Table 4-1: Types of commercial property/critical infrastructure at risk of flooding (1:200yr event, 2115)

Commercial Properties at Risk of Flooding							
Property Type	**SMZ 3a**	**SMZ 3b**	**SMZ 3c**	**SMZ 5a**	**SMZ 6a**	**SMZ 6b**	**SMZ 6c**
General commercial (shops/warehouses/offices)	22	5	21	1	125	11	9
Supermarket	0	0	0	0	2	0	0
Restaurants/cafes/pubs	2	0	0	0	9	0	1
Warehouses	5	10	8	0	77	7	2
Leisure facilities (including sports centres)	0	0	1	0	2	0	0
Public buildings	6	1	0	0	9	0	1
Schools	1	0	0	0	0	0	0
Industrial sites	1	2	1	3	15	4	2
Car parks	2	0	1	0	5	0	1
Electricity sub-stations	0	0	6	0	15	0	0

Flood depths for each individual properties were obtained by conducting point inspections in GIS using the property location and the flood modelling for each flood modelling scenario.

Similar to the approach with residential properties, individual commercial properties at risk of erosion were also obtained by a point inspection in GIS. Properties within the SMP erosion prediction lines were identified. Where properties were at risk of both coastal erosion and flooding, PV flood damages were accrued up to the year of erosion write-off, at which point the property was removed from the flood damage appraisal.

The commercial properties were valued on the rateable value for their business type (provided by the valuation office). Average values for retail, workshop, warehouses and offices between £60/m2 and £90/m2 were estimated and then multiplied by the building flood space to estimate the rentable value of the business. In accordance with the FCERM-AG guidance, the rentable values were then divided by the business yield (~6%) to provide an estimate of the market value for flood damage capping and write off purposes.

A manual check was carried out to ensure that the property valuations were realistic in relation to asset size and function. Where required these property values were estimated based on the construction costs of similar commercial properties or developments.

4.3 Number of properties at risk of flooding (residential and commercial) – 'Do Nothing' Scenario

The total number of properties at risk of flooding and erosion in each SMZ is provided in Table 4-2.

Table 4-2: Number of properties at risk from flooding (1:200yr event) over the next 100 years

SMZ	Year	Residential properties at risk of flooding (1:200 event)	Commercial properties at risk of flooding (1:200 event)	Total properties at risk of flooding (1:200 event)
3a	2015	13	28	41
	2025	15	33	48
	2055	18	29	47
	2115	41	36	77
3b	2015	4	12	16
	2025	4	13	17
	2055	3	13	16
	2115	4	15	19
3c	2015	12	16	28
	2025	17	18	35
	2055	28	19	47
	2115	53	24	77
5a	2015	38	5	43
	2025	38	5	43
	2055	32	4	36
	2115	4	4	8
5b	2015	2	2	4
	2025	3	3	6
	2055	7	1	8
	2115	0	0	0
6a	2015	122	195	317
	2025	131	214	345
	2055	137	235	372
	2115	195	228	423
6b	2015	4	9	13
	2025	6	9	15
	2055	16	12	28
	2115	43	18	61
6c	2015	7	9	16
	2025	11	11	22
	2055	3	3	6
	2115	19	11	30
Total	2015	202	276	478
	2025	225	306	531
	2055	244	316	560
	2115	359	336	695

4.4 Overview of 'Do Nothing' Flood Damages

The annual average (cash) damages (including intangibles) were discounted over the appraisal period to calculate the whole life PV damages. Cumulative PV damages across the entire strategy frontage and in each separate SMZ are presented in Figure 4-9 and Figure 4-10.

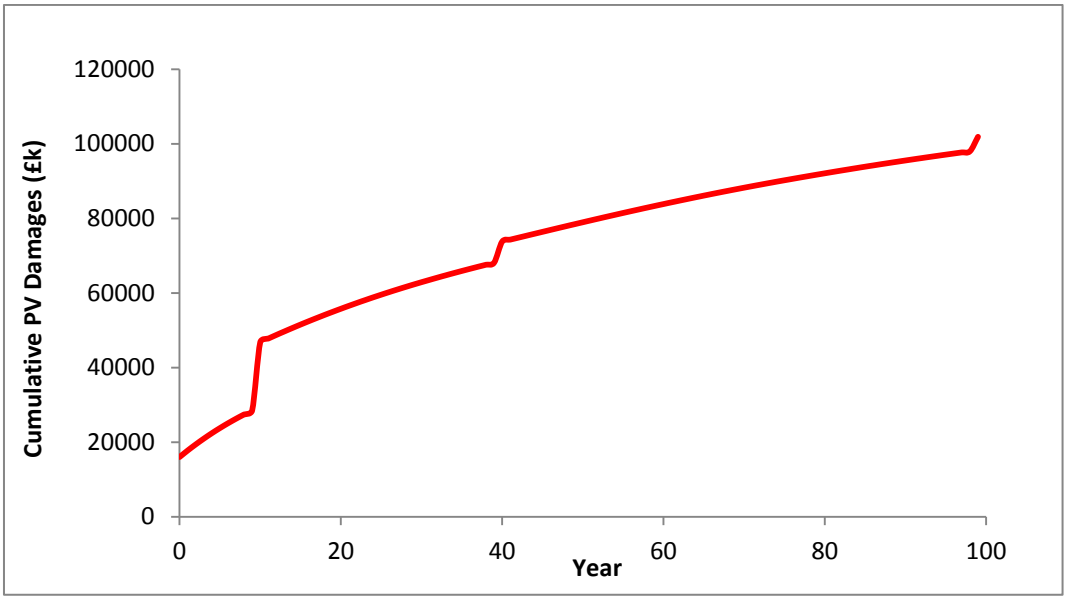

Figure 4-9: Cumulative PV flood damages (£k) across entire strategy frontage during the appraisal period

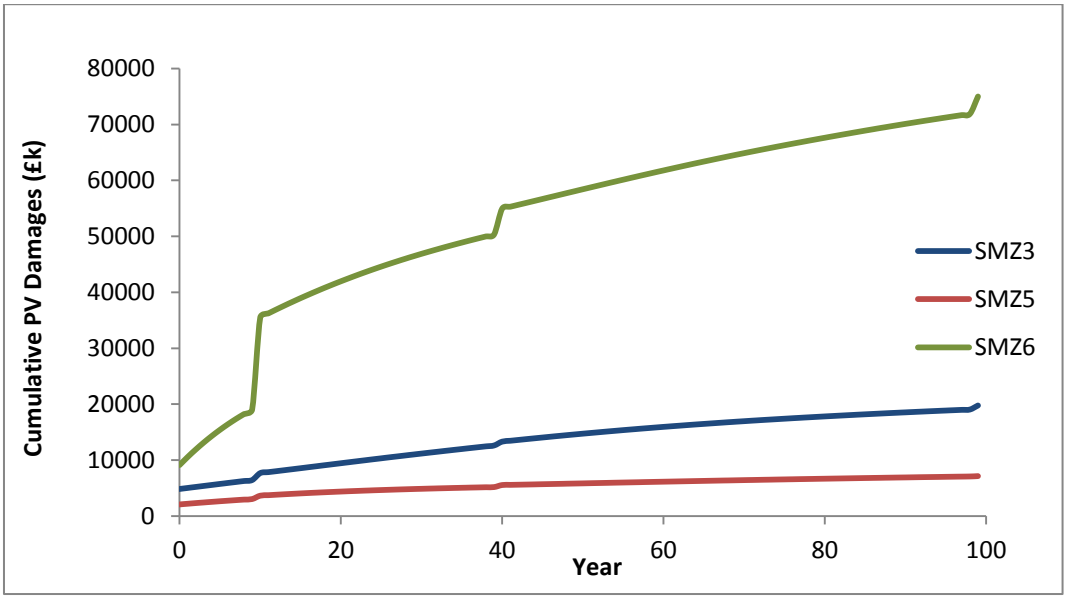

Figure 4-10: Cumulative PV flood damages (£k) across each SMZ during the appraisal period

The step in damages in Years 0, 10, 40 and 99 are due to the write-off of a significant number of properties due to flooding during a 1:3 year return period or less leading to write-off and also because of capping of flood damages.

4.4.1 Write-off damages

The occurrence of property write off for residential and commercial property is shown below (Figure 4-11 and Figure 4-12) using non-discounted property values. The impact of sea level rise can be seen by the rise in write off in year 99 due to the impact of sea level rise leading to flooding on a 1:3 year return period or less.

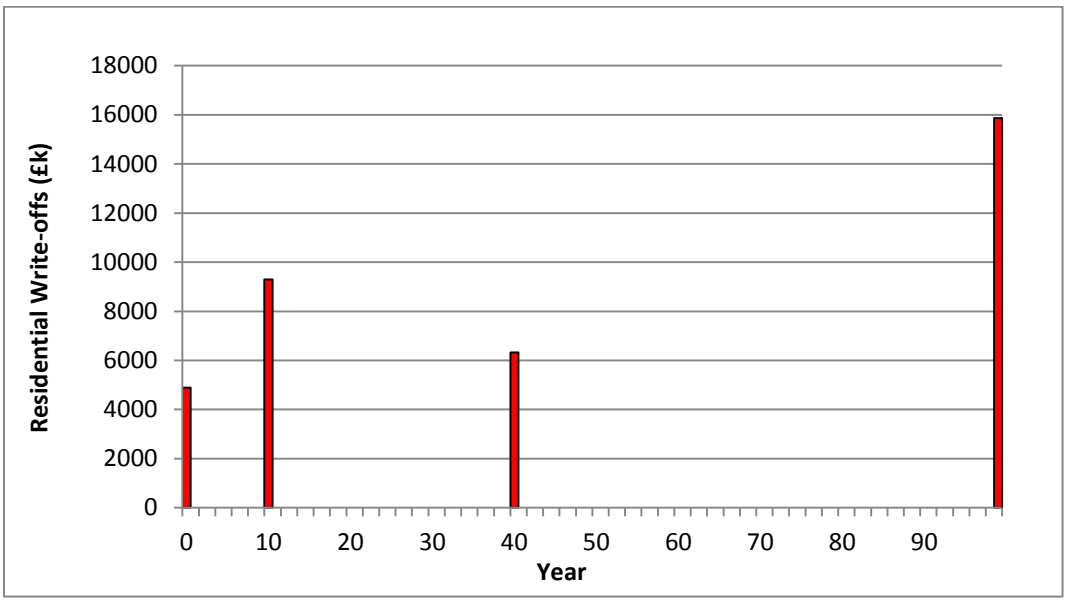

Figure 4-11: Residential Write-off damages (£k) during the appraisal period

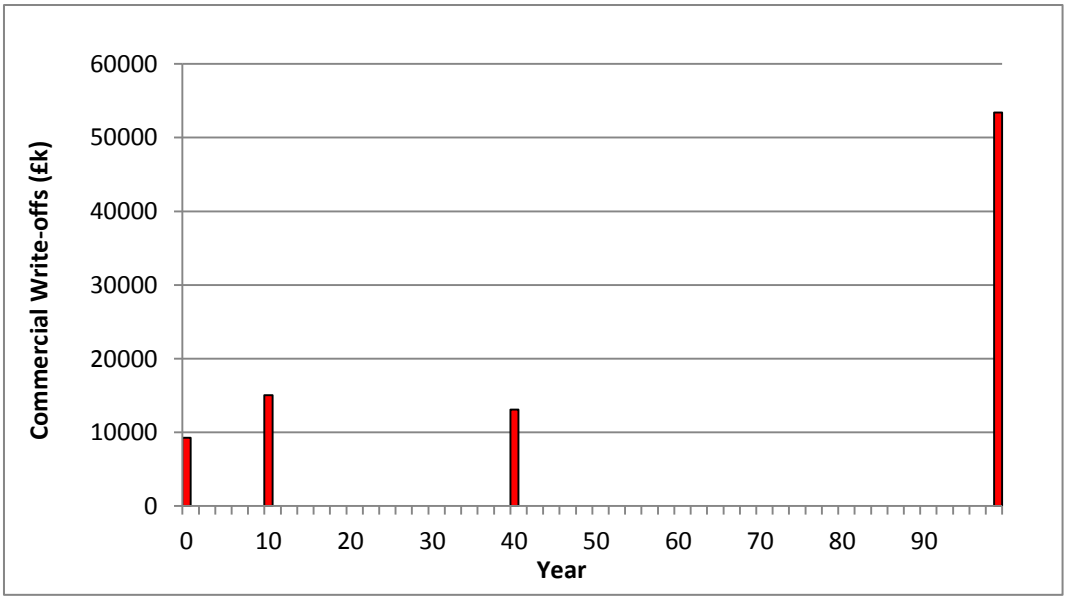

Figure 4-12: Commercial Write-off damages (£k) during the appraisal period

4.5 Number of properties at risk of erosion

Assets were included in the erosion risk bands if any part of the building fell within that erosion zone. This is because any property which is within the erosion risk bands would be at significant risk of immediate failure and would be uninhabitable. The properties in an erosion zone were assumed to erode in the middle year of the erosion zone i.e. any properties in the 2015-2025 zone were assumed to fail on 2020, and the discounted damages taken in this year. The last erosion zone of 60 years was split into two zones of 30 years so that the distribution and discounting of damages were more suitably represented over the Strategy period.

The OS Mastermap building outlines were used to assess the assets at risk by comparing their position in relation to the erosion zones.

Whilst the erosion zones did not cover Newport it has been considered that if the harbour walls failed under a 'Do Nothing' Scenario, a number of properties in close proximity would be expected to be at risk of loss. To reflect this in the 'Do Nothing' scenario any properties within 10m of the Newport harbour walls were assumed to fail/erode in the same year the wall is predicted to fail.

The number of properties at risk of erosion is presented by SMZ over time in Table 4-3.

Table 4-3: Number of properties at risk from erosion over the next 100 years

SMZ	Year	Residential properties at risk of erosion	Commercial properties at risk of erosion	Total properties at risk of erosion
1	2025	1	0	1
	2055	5	2	7
	2085	11	7	18
	2115	27	8	35
2	2025	4	0	4
	2055	62	24	86
	2085	179	71	250
	2115	284	110	394
3a	2025	0	0	0
	2055	15	30	45
	2085	38	43	81
	2115	130	64	194
3b	2025	0	0	0
	2055	1	0	1
	2085	2	0	2
	2115	2	0	2
3c	2025	0	0	0
	2055	0	2	2
	2085	11	4	15
	2115	11	5	16
4	2025	0	1	1
	2055	7	5	12
	2085	13	16	29

	2115	32	27	59
5a	2025	0	0	0
	2055	18	1	19
	2085	32	2	34
	2115	52	2	54
5b	2025	0	0	0
	2055	33	11	44
	2085	106	34	140
	2115	228	41	269
6a	2025	0	0	0
	2055	45	53	98
	2085	91	109	200
	2115	180	153	333
6b	2025	0	0	0
	2055	0	4	4
	2085	0	6	6
	2115	0	9	9
6c	2025	0	0	0
	2055	14	15	29
	2085	14	15	29
	2115	24	15	39

4.5.1 Gurnard to Cowes potential reactivation zone

In Section 3.3.3 it was explained that a potential reactivation zone has been identified between Gurnard and Cowes (SMZ5b) and how an assessment of damages has been made. The properties assessed to be at risk from erosion in this zone over the next century under a Do Nothing scenario are 247 residential properties and 10 commercial properties.

4.6 Summary of 'Do Nothing' Flood and Erosion Damages

The PV whole life damages for each SMZ under the baseline 'Do Nothing' scenario is presented below in Table 4-4.

Table 4-4: Present value damages expected in each SMZ over the next 100 years (to 2115) under the baseline Do Nothing approach

SMZ	PV Flooding (£k)	PV Erosion (£k)	PV Indirect (£k)	PV Total (£k)
1	£0	£1,699	£0	£1,699
2	£0	£11,877	£1,310	£13,187
3a	£3,569	£7,307	£25,120	£35,996
3b	£1,993	£217	£1,139	£3,349
3c	£6,834	£1,592	£1,928	£10,354
4	£0	£2,069	£0	£2,069
5a	£2,076	£2,334	£1,930	£6,340
5b	£141	£23,144	£595	£23,879
6a	£55,657	£12,894	£24,094	£92,645
6b	£1,840	£77	£650	£2,568
6c	£2,114	£2,961	£573	£5,648
All	£74,223	£66,169	£57,339	£197,732

The flood and erosion asset damage (residential and commercial properties) forms the most significant part of the total damages expected across the frontage under the 'Do Nothing' scenario.

The majority of damages are in SMZ6 containing the most populated areas of Cowes, East Cowes and Newport.

The SMZ with the next most damages is SMZ3 containing Yarmouth. SMZ1 and SMZ4 have the smallest potential damages under the 'Do Nothing' scenario. This is related to the largely undeveloped nature of the coastline in these areas.

4.7 Breakdown of 'Do Nothing' Damages by Damage Category

As described in Section 3.4, as well as direct flood and erosion damages, a number of indirect damages have been considered in this economic assessment.

Table 3-5 below shows the PV total 'Do Nothing' damages broken down into different damage categories. Figure 4-13 to Figure 4-24 below present how the different types of damages are proportioned.

Table 4-5: Present value Do Nothing damages, broken down into types of damage categories

Type of Damage (PV)		SMZ1	SMZ2	SMZ3a	SMZ3b	SMZ3c	SMZ4	SMZ5a	SMZ5b	SMZ6a	SMZ6b	SMZ6c	Total
Total damages	£k	£1,699	£13,187	£35,996	£3,349	£10,354	£2,069	£6,340	£23,879	£92,645	£2,568	£5,648	**£197,732**
	%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	**100%**
Flooding - direct	£k			£3,569	£1,993	£6,834		£2,888	£141	£55,657	£1,840	£2,114	**£75,036**
	%			10%	60%	66%		46%	1%	60%	72%	37%	**38%**
Flooding - intangible	£k			£1,873	£463	£1,391		£409	£85	£6,230	£282	£386	**£11,119**
	%			5%	14%	13%		6%	0.4%	7%	11%	7%	**6%**
Flooding - loss of life	£k			£466	£112	£538		£708	£102	£4,160	£225	£187	**£6,498**
	%			1%	3%	5%		11%	0.4%	4%	9%	3%	**3%**
Erosion - direct	£k	£1,699	£11,877	£7,307	£217	£1,592	£2,069	£2,334	£10,581	£12,894	£77	£2,961	**£53,607**
	%	100%	90%	20%	6%	15%	100%	37%	44%	14%	3%	52%	**27%**
Erosion - landslide reactivation zone	£k								£12,563				**£12,563**
	%								53%				**6%**
Visitor numbers	£k		£1,310	£3,580					£407	£2,660	£143		**£8,100**
	%		10%	10%					2%	3%	6%		**4%**
Transport - road infrastructure	£k			£13,679									**£13,679**
	%			38%									**7%**
Transport - ferry terminals	£k			£5,522						£11,044			**£16,566**
	%			15%						12%			**8%**
Transport - cyclepath	£k				£564								**£564**
	%				17%								**0.3%**

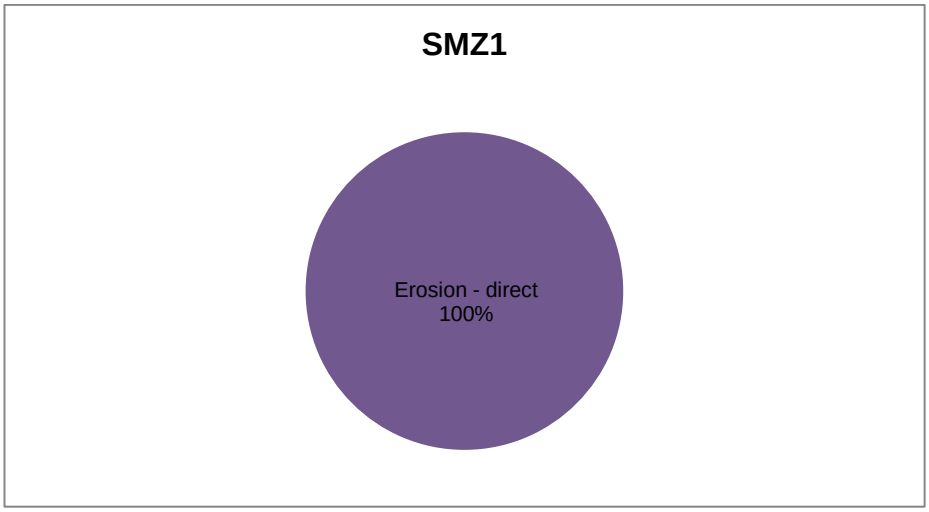

Figure 4-13: Breakdown of whole life 'Do Nothing' damages in SMZ1

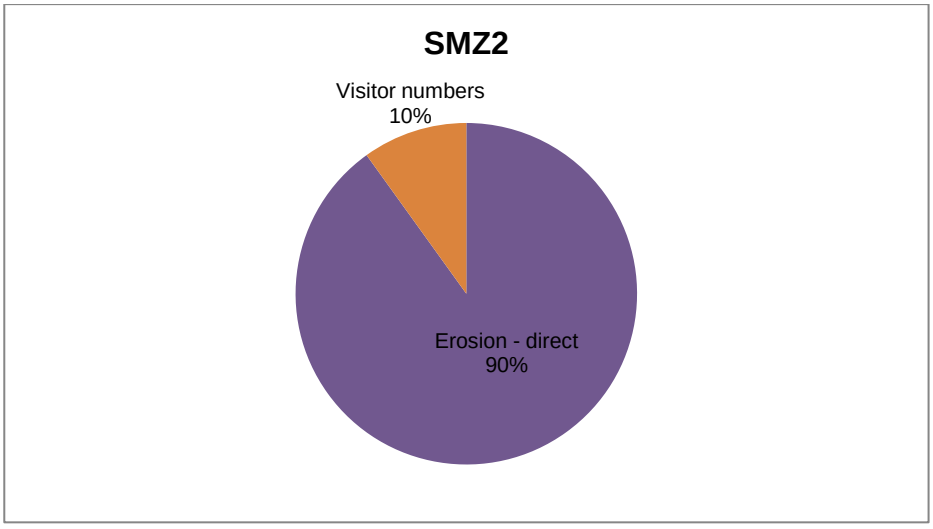

Figure 4-14: Breakdown of whole life 'Do Nothing' damages in SMZ2

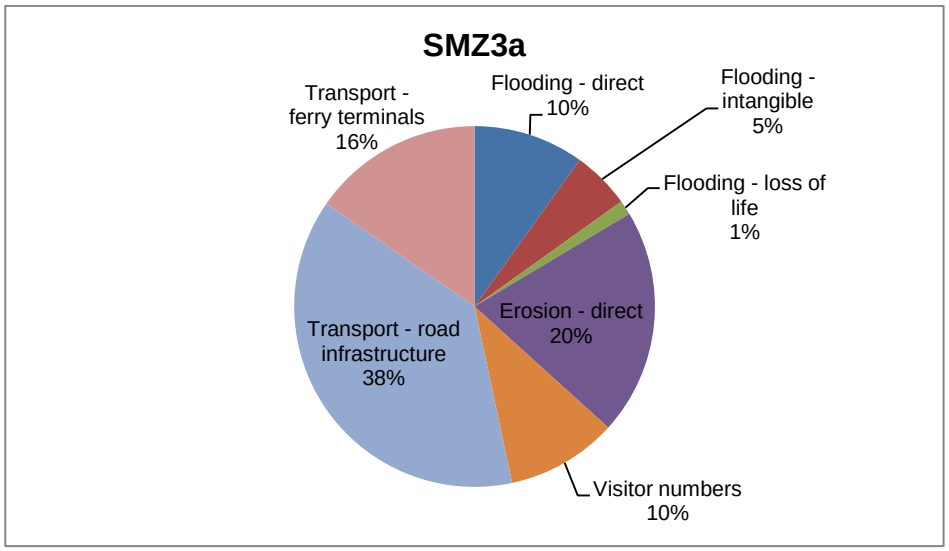

Figure 4-15: Breakdown of whole life 'Do Nothing' damages in SMZ3a

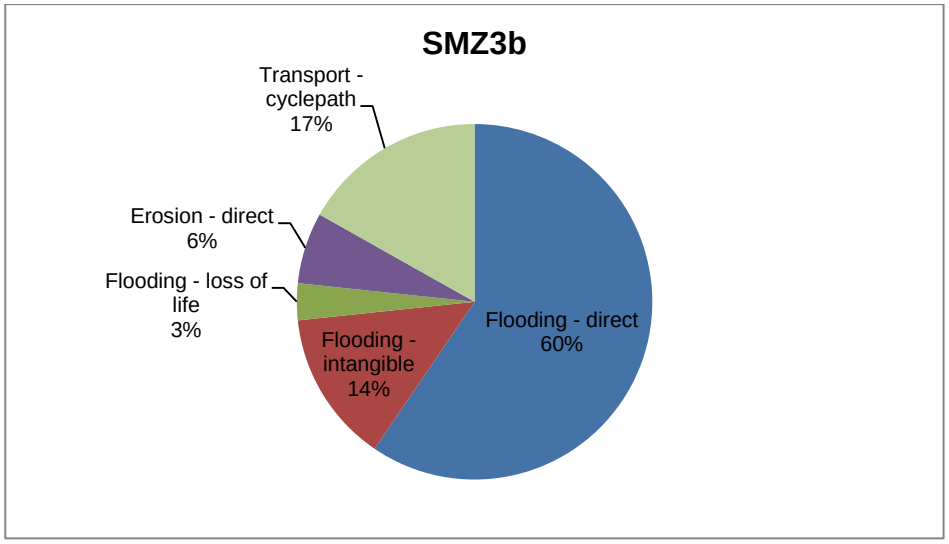

Figure 4-16: Breakdown of whole life 'Do Nothing' damages in SM3b

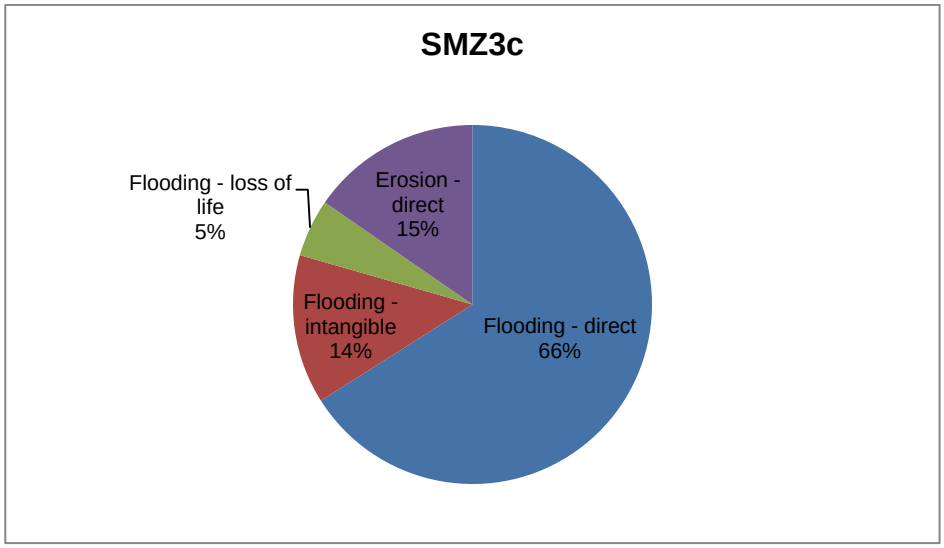

Figure 4-17: Breakdown of whole life 'Do Nothing' damages in SMZ3c

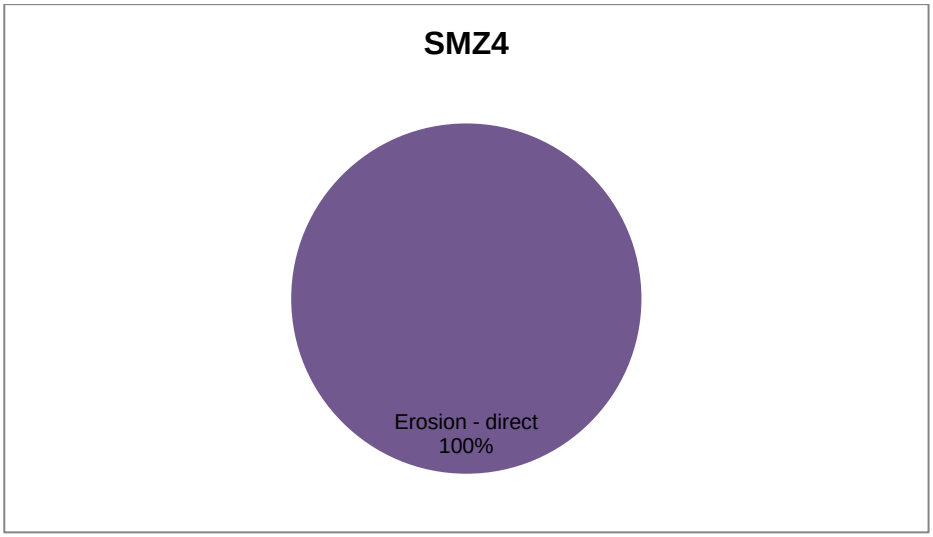

Figure 4-18: Breakdown of whole life 'Do Nothing' damages in SMZ4

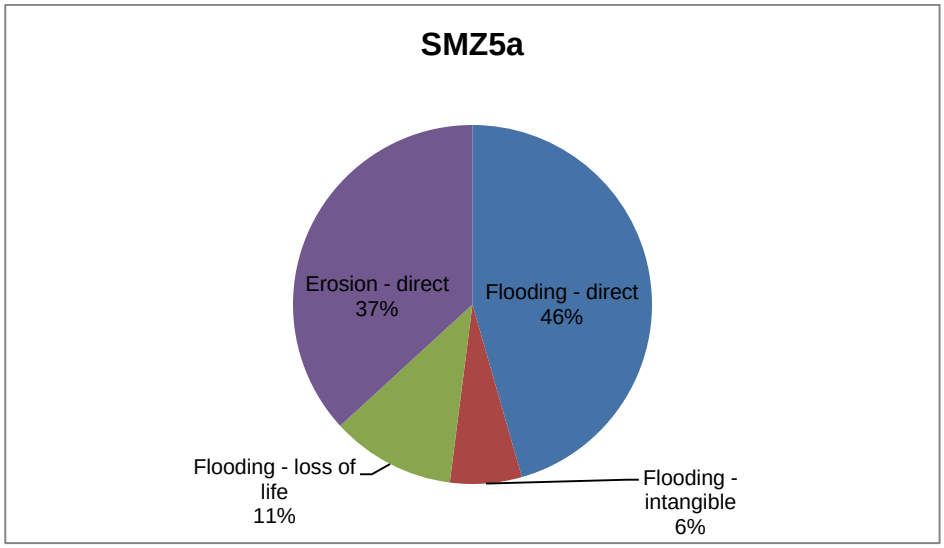

Figure 4-19: Breakdown of whole life 'Do Nothing' damages in SMZ5a

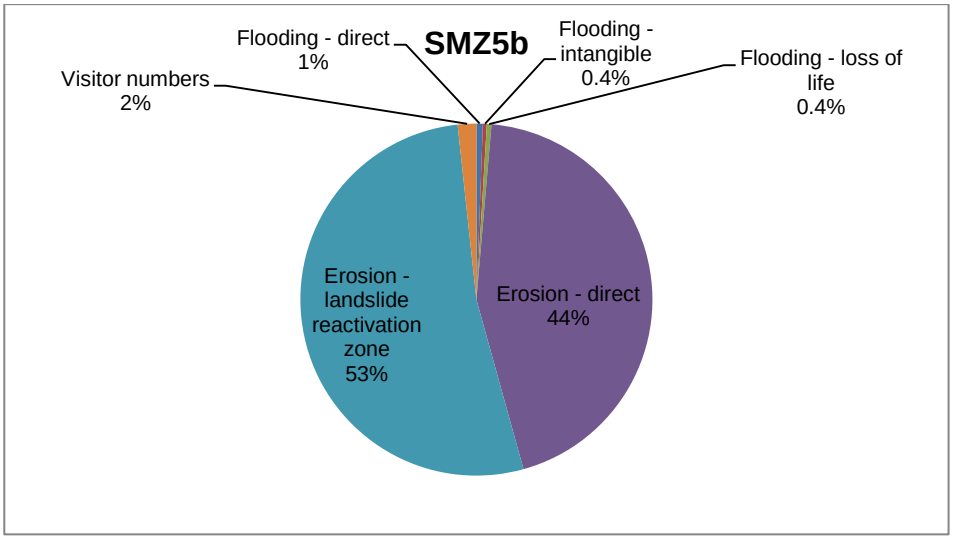

Figure 4-20: Breakdown of whole life 'Do Nothing' damages in SMZ5b

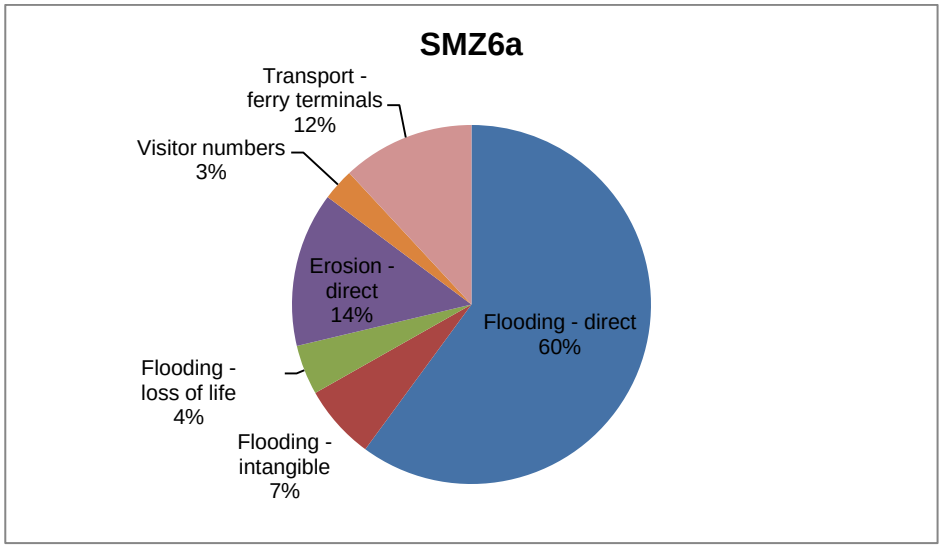

Figure 4-21: Breakdown of whole life 'Do Nothing' damages in SMZ6a

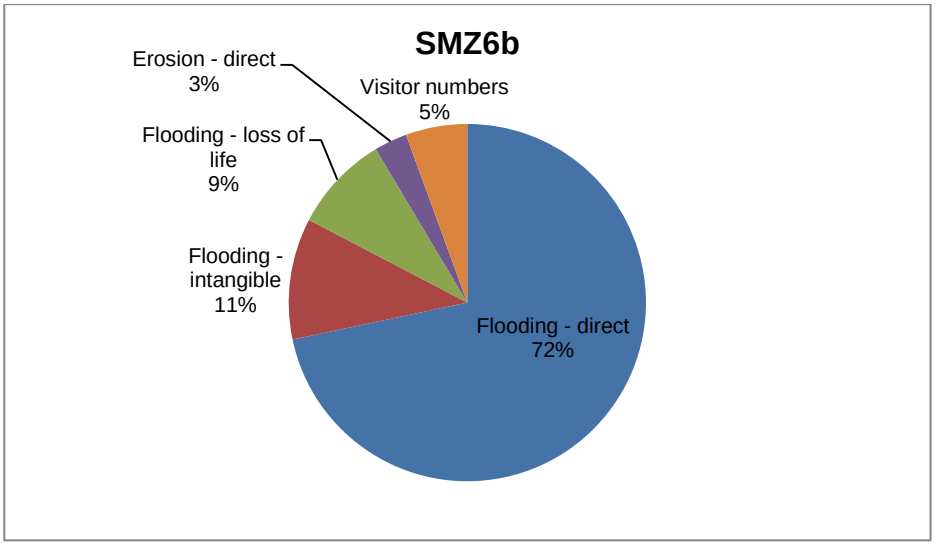

Figure 4-22: Breakdown of whole life 'Do Nothing' damages in SMZ6b

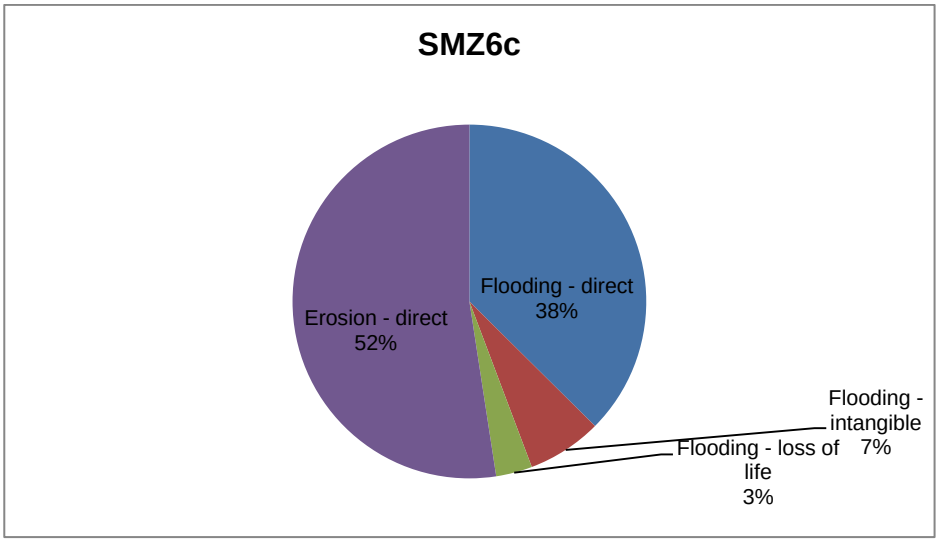

Figure 4-23: Breakdown of whole life 'Do Nothing' damages in SMZ6c

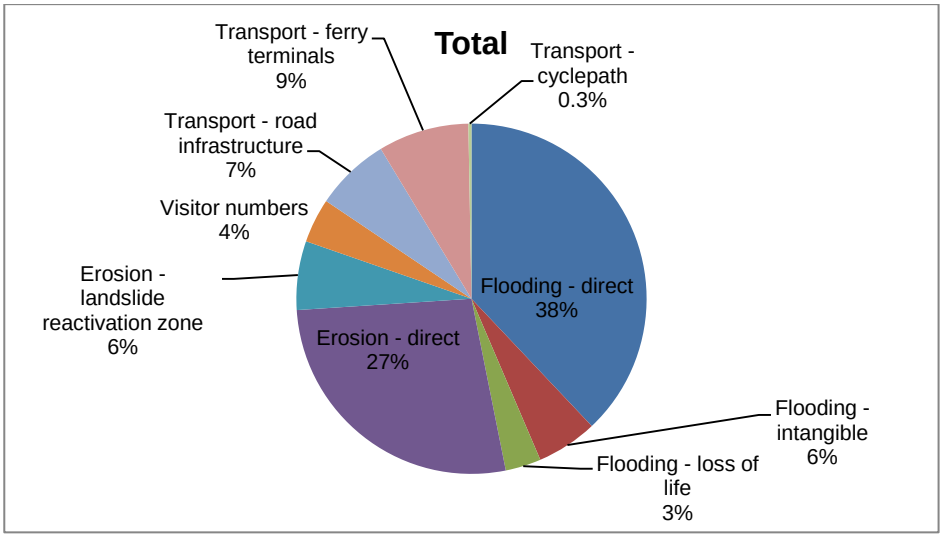

Figure 4-24: Breakdown of whole life 'Do Nothing' damages across all SMZs

The majority of damages across all the SMZs are from direct flood and erosion damages. The next largest damage category, damages from flooding and erosion to the ferry terminals, is relatively small (12 – 16% in relevant units) in comparison to the direct and overall damages. The damages other than the direct damages are spread across a number of indirect damages categories.

5. Costing the Options

In order to compare the relative economic merits of the options and to generate the benefit cost ratios against the 'Do Nothing' baseline scenario, outline costs for the different strategic options were estimated.

For each strategic option, the costs were developed and built up on an ODU by ODU basis. The total strategic option cost was then calculated as the sum of all the ODU costs within that particular SMZ. For each ODU, the defence structure, defence length/height and timing of capital works and maintenance were established in the option development phase of The Strategy. This information was used to cost each of the strategic options and the breakdown of cash costs of the preferred options for each ODU are presented in Appendix 1.

5.1 Approach to Capital Construction Costs

The cost estimations for capital works were undertaken using the best available information from a variety of sources. In the first instance, where actual defence costs were available from previous projects or published data, these costs have been used as a basis for relevant options in this study.

In the absence of 'real' costs, values have been estimated from rates provided in civil engineering price books (e.g. SPONS, 2014) and Environment Agency guidance, coupled with experience of costs from similar projects. The indicative costs are presented as of July 2015.

For a number of the defence structures considered, the cost of the structure varied with height (floodwalls and embankments). Therefore, it was necessary to determine the height of the structure that was required. This information was attained by undertaking a GIS analysis and creating indicative defence structure alignments. Using defence crest survey data of the entire strategy frontage, the average shoreline elevation across the indicative alignments was identified. This allowed the necessary height of each defence structure to be established.

The following sections summarise the costing basis and assumptions for different management structures which comprise the Strategy options. The breakdown of cash costs (not discounted at this stage) for the capital works and maintenance to implement the preferred options are provided by SMZ in Appendix 1.

Setback Floodwall

Unit rates per metre for setback flood defence walls were estimated using civil engineering price books (e.g. SPONS 2014) coupled with experience of costs from similar projects and benchmarking against information obtained from contractors. A standard indicative cross section was adopted to cost the structures. An example of the setback floodwall typical section assumed for costing is provided in Figure 5-1.

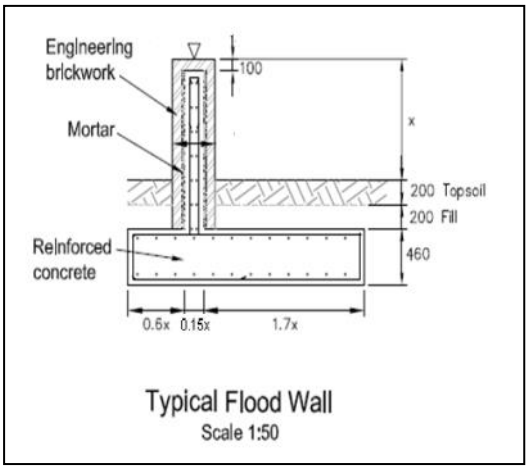

Figure 5-1: Indicative flood wall cross section

The costing of the walls included allowance for the following aspects and materials:

- Excavation and disposal
- Trimming of excavation
- Topsoil
- Fill
- Facing brickwork
- Engineering brickwork
- Concrete top – design mix
- Placing of concrete
- Reinforcement of concrete
- Formwork
- Trimming of filled surfaces
- Drainage
- Seeding

By multiplying the relevant unit costs of the required height of floodwall by the defence lengths the capital construction costs were estimated for the floodwalls.

Crest Raising

Crest raising was included in options where floodwalls were periodically raised to increase the standard of protection offered. This option was only considered for existing structures where crest raising would be technically feasible and for floodwalls built in the future. To represent the cost of crest raising, the cost was taken as equivalent to that of a new low height floodwall construction minus the cost of the foundation base.

Mass Rock Revetment

Unit rates per metre for mass rock revetments were estimated using civil engineering price books (e.g. SPONS, 2014) coupled with experience of costs from similar projects. This structure was designed as an option for areas where there is a landslide risk and any coastal protection structure may need to be flexible to accommodate some movement. The revetment structure's rough surface and slope would dissipate wave energy and reduce overtopping. The structure is more than rock armour because the large amount of rocks themselves will provide a super incumbent weight at the toe; toe weight is important in reducing further movement.

The costing of the revetment included allowance for the following aspects and materials:

- Geotextile

- Core
- Underlayer
- Rock armour
- Safety handrails

Property Level Protection (PLP)

Cost estimates for property level protection have been based on an allowance of up to £5000 which is typically sufficient to provide a basic package of PLP measures. This amount covers the installation of items such as door defenders, airbrick covers, backwater valves as well as the material and fitting costs per property and any liaison/engagement costs that may be associated with the protection.

When property level protection was considered, the properties in need of protection were identified in GIS with use of the flood modelling results

Frontline Wall

Unit rates per metre for frontline defence walls were estimated using civil engineering price books (e.g. SPONS 2014) coupled with experience of costs from similar projects and benchmarking against information obtained from contractors. A standard indicative cross section was adopted to cost the structures. An example of the frontline wall typical section assumed for costing is provided in Figure 5-2.

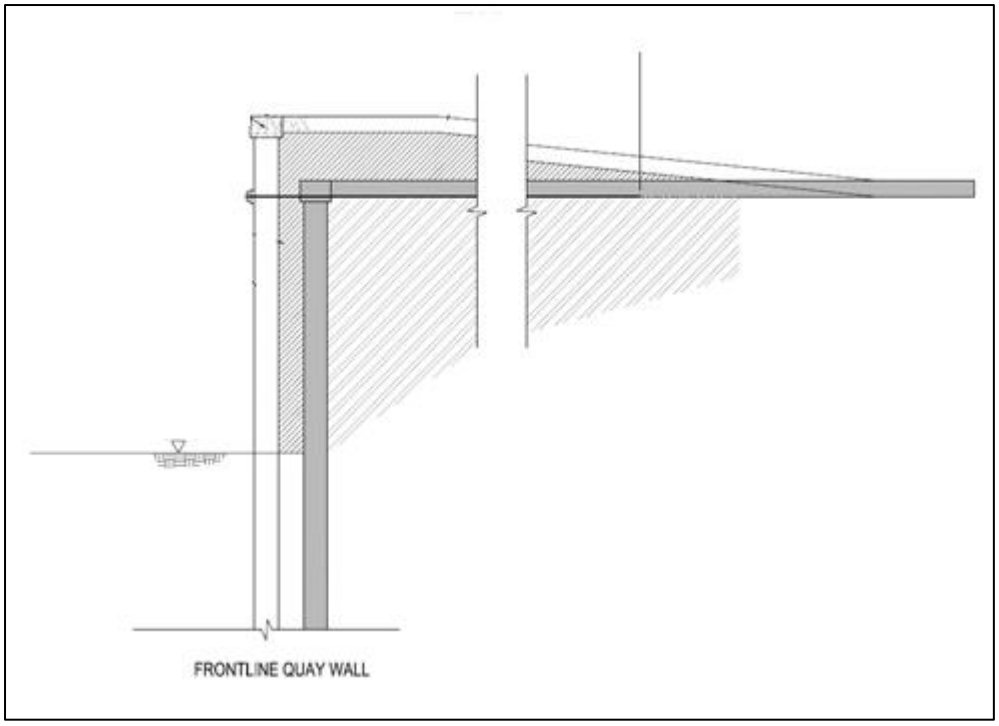

Figure 5-2: Indicative cross section of the frontline wall structure

The costing of the walls included allowance for the following aspects and materials:

- Piling rig and driving
- Sheet piles
- Backfill
- Anchor plant and ties
- Reinforcement
- Formwork

- Concrete

When estimating the cost of floodwalls the price per m is assumed to not vary with different water levels. This is because compared to the overall length of the piling, variations in water level will have little effect.

Cliff Drainage

Unit rates per metre for cliff drainage were estimated based on previous engineering experience from similar projects, where installing shallow cliff drainage had been used as a method of cliff stabilisation.

Temporary Flood Barriers

Unit rates per metre for 0.9m temporary flood barriers were estimated by obtaining quotations from suppliers. The rate includes the barriers, weighted connection keys and hubs. In addition to this, an allowance was also made for likely storage and deployment costs. The temporary flood barriers can be quickly deployed and when assembled fill with the rising flood waters.

Seawall Refurbishment Using Sprayed Concrete

Whilst proactive maintenance can increase the residual life of structures, the Environment Agency guidance (SC080039/R7) suggests that with a typical regime of maintenance once structures have a residual life of 30 years or less remaining that following this regime will not extend the life of the structure much more than a policy of 'Do Nothing'. Therefore even with a typical maintenance regime many of the structures within the Strategy area would fail before the end of the Strategy period. Therefore at the end of a structure's predicted residual life a refurbishment cost has been considered. The estimated rate for refurbishment work that has been applied is £250/m^2 based on the area of the seawall face (prior to optimism bias).

This cost has been based on quotes obtained for seawall refurbishment for two different heights of structures using a sprayed concrete technique. This type of refurbishment would offer protection for approximately 20 years before having to be repeated. It has been considered that some defences are not going to be able to be refurbished this way, whether it is suitable depends on the type of structure and how it is failing.

Summary

Table 5-1 provides a summary of the estimated unit costs for the different management structures used when producing the costs for each strategic option. These costs allowances where needed for design/preliminaries/scale of works/overheads.

Table 5-1: Summary of unit costs (£) for different defence types (prior to optimism bias)

Defence Type	Unit	Cost (£)	Based On
Mass Rock Revetment	m (length)	£3,900	to protect 2.7m high seawall
Setback Floodwall	m (length)	£1,700	1m height
Property Level Protection	per property	£5,000	
Frontline Wall	m (length)	£12,900	pile height approx. 6m above GL
Cliff Drainage	m (length)	£3,000	
Temporary Flood Barriers	m (length)	£320	0.9m height
Seawall Refurbishment Using Sprayed Concrete	m^2	£250	

5.2 Do minimum, Health and Safety, Access

A 'Do Minimum' management approach was costed. Do Minimum' costs have been based on data from the IoW Council showing how much has been spent in each ODU repairing defences, maintaining access to coastal frontages and providing health and safety measures over a 69 month period (2009 – 2015). Most of the expenditure was for 'Do Minimum' works, any works that were more than this were removed. The average annual spend over the last 5 years was divided by the approximate length of existing structures in the Strategy area to provide an annual unit rate for the 'Do Minimum' approach. In ODUs where there are no existing defences an annual cost of £200 was used for access and health and safety.

This does not include major repairs/refurbishment to structures that have reached the end of their design life. During the condition assessment of structures on the Island, when determining the residual life of a structure the maintenance regime selected was low/basic do-minimum.

In ODUs that are at risk of flooding an annual cost of providing an early flood warning system and emergency response plan was included into the 'Do Minimum' option at an annual cost of £500. This would include a community subscribed system to inform of flood warnings and an emergency services and evacuation plan. In some ODUs that are at risk of erosion the cost of a coastal change management area plan has been included into the 'Do Minimum' option at an estimated cost of £10000. This would include a report to inform future planning and development in the area.

5.3 Maintenance Costs

In addition to capital construction costs, maintenance costs also contributed to the whole life scheme costs that were estimated. Maintenance costs refer to the costs for periodic or annual maintenance works that are required to maintain the structural integrity of the defences.

Maintenance costs were based on information from the IoW Council that in order to achieve a medium maintenance regime, approximately twice the current annual expenditure would need to be spent. The IoW Council provided information of the expenditure on maintaining the coastal frontages in the last 5 years. Twice average annual spend over the last 5 years was divided by the approximate length of existing structures on the island to provide an annual unit rate of maintenance.

To contribute towards the whole life costs of each strategic option, the maintenance cost was applied annually to existing defences in each ODU. It was also applied to new structures, but it was assumed that for the first 20 years after capital construction no maintenance would be required.

For less typical defence structures other maintenance costs have been used. It has been assumed that property level protection will have a design life of 20 years before being needed to be replaced.

Temporary flood barriers are assumed to have a typical design life of 20 years before being needed to be replaced and have an annual maintenance cost of £2000 per area (dependent on areas being 200m to 500m in length) which includes storage and deployment.

5.4 Discounting

Discounting is a technique used to compare costs (and benefits) that occur at different points in the appraisal period, or over different time periods. Standard discount rates have been used to convert all costs to 'present value' (PV) costs so that the whole life costs of each option can be compared. According to FCERM-AG, the following variable discount rates (expressed as a %) have been used within the economic assessment appraisal; 3.5% for years 0 to 30, 3% for years 31 to 75, and 2.5% for years 76 to 99.

Using these discount rates over the 100 years appraisal period, a total PV cost for each ODU option was determined. The PV costs from each ODU were then summed to provide a total PV cost for each strategic option which can be found in Table 7-1 to Table 7-11.

5.5 Optimism Bias

In line with FCERM-AG policy, an optimism bias of 60% was applied to the present value whole life costs for each strategic option. Optimism bias;

"is included to account for the tendency for appraisers to be overly optimistic in early assessment of project costs, timescales and benefits in comparison to the final values. This 'optimism' is a result of uncertainty in the final design detail and implementation as a result of high level strategic approach required at this stage.

To counter this, the HM Treasury issued guidance in the form of a percentage to increase the present value costs depending on the uncertainty surrounding the estimates. This guidance has been adopted within the FCERM-AG. With regard to Coastal Strategies the FCERM-AG recommends an optimism bias level of 60% as these projects are typically at an early stage and adopt a higher level approach to design and costing" (Flood and Coastal Erosion Risk Management appraisal guidance – environment agency, 2010).

A few exceptions have been made. The costs of Property Level Protection have not included any optimism bias because they are based on a standard grant allowance any therefore are unlikely to differ from this. Also the cost for an early flood warning and emergency response plan described above does not also have optimism bias added on to it.

The costs of Temporary Flood Barriers have included optimism bias of 30%; a lesser amount has been used because there are no ground investigations required and therefore more certainty about the design of the defence.

6. Option benefits and residual damages

6.1 Option Benefits

Following an estimation of Do Nothing Damages, the benefits (damages avoided and additional positive impacts of options delivered) were estimated for each of the options being appraised. This exercise accounted for the timing and standard of protection offered by the options in question.

Generally, the whole life strategy option benefits were calculated by subtracting the residual damages (see below) from the benefiting portion of the baseline Do Nothing damages to determine the value of damages avoided and hence the level of flood and erosion protection benefits provided by the proposed works in each SMZ.

The benefits for each strategic option were then divided by the cost of the option to give the benefit-cost ratio.

6.2 Residual damages

Option residual damages are those damages that would still occur after an option has been implemented. These have been included within the economic assessment.

The difference between the value of option residual damages for a particular option and the 'Do Nothing' damages gives the value of the benefits for that option. The option residual damages, benefits and benefit cost ratios for the 'Do Something' options were determined.

The residual damages were considered based on the type and timing of the proposed defences. For example, where a 1:75 year (1.33%AEP) flood SoP is proposed through construction of flood walls, the residual risk of flood damages to properties behind the defence line only occurs during events greater than 1:75 years. The effect of sea level rise was also considered. The predicted water level of a 1:75 year event in the present day will be smaller than the water level for the same probability event in the future. Structures were costed so they achieved their intended SoP at the end of their design life. Therefore before this time the flood defence structure will actually provide a higher SoP.

When there were damages counted for two-stage options, for example providing a lower standard of protection in the short to medium term and then providing new defences to increase the standard of protection in the long term, damages were calculated continuously over the 100 year appraisal period based on the defences in place at the time of flooding or erosion. This meant that there was no double counting of benefits, if a property was written-off in the short to medium term which would have been protected by the future long term defences, no benefits were counted in the long term for this property.

When calculating residual damages for the Property Level Protection options it was considered that damages would still occur if the flood depth was larger than 0.6m to reflect the limitations of this option. Furthermore, to conservatively reflect residual risk associated with this option only 75% of the Do Nothing damages were counted as benefits. This was because property level protection will only be effective if it is properly deployed and there is a chance of equipment failure and residual risk.

It was also considered that Temporary Flood Barriers carry some residual risk (i.e. associated with deployment or the seals etc) and some seepage could occur; to reflect this only 80% of the Do Nothing damages were counted as a benefit in this option.

Whilst residual 'loss of life' damages were assumed to be zero (therefore all the benefits were taken) for options where the SoP was improved, for the flood warning and PLP options only half of the loss of life benefits were counted. Similarly where there were visitor damages it was assumed that some of this would continue to occur with the do minimum (health and safety) option compared to improve options that would prevent all visitor damages.

7. Average Benefit-Cost Ratio

Cost-benefit values were calculated for each of the options to demonstrate their economic viability and relative merits on a SMZ by SMZ basis. This was used to inform the selection of the preferred strategic options. Following the proposed approach from the FCERM-AG guidance, the leading option based on highest benefit cost ratio, was identified.

It should be noted that option costs and benefits are presented in the document in Present Value (PV) terms (unless otherwise stated). PV describes the whole life costs and benefits spread over the next 100 years and including a discount factor (providing the worth of future sums of money). The undiscounted cash costs of the options will exceed the PV values presented.

Presented in the following tables are the whole life present value costs, benefits, residual damages and benefit-cost ratio of each strategic option at each SMZ. The preferred strategic option for each SMZ is highlighted in red. For more information regarding the selection of the preferred option refer to Appendix J – Option Development and Appraisal.

Table 7-1: PV costs, PV benefits and cost-benefit ratio of the strategic options considered in SMZ 1

SMZ 1						
Strategic Option No.	**Strategic Option Name**	**Strategic Option Description**	**Cost to implement option (PV £k)**	**Benefit of option (PV £k)**	**Residual Damage of option (PV £k)**	**Benefit : Cost Ratio**
1	Do Nothing	No active intervention. Baseline scenario	£0	£0	£1,699	-

Table 7-2: PV costs, PV benefits and cost-benefit ratio of the strategic options considered in SMZ 2

SMZ 2						
Strategic Option No.	**Strategic Option Name**	**Strategic Option Description**	**Cost to implement option (PV £k)**	**Benefit of option (PV £k)**	**Residual Damage of option (PV £k)**	**Benefit : Cost Ratio**
1	Do Nothing	No active intervention. Baseline scenario	£0	£0	£13,187	-
2	Do Minimum*	Maintain H&S and access as long as possible and develop coastal change management area plan (W2-W6). (*W7 is Do Nothing)	£308	£931	£12,256	3.0
3	Maintain then Improve from 2025	Phased seawall improvement and cliff stabilisation. Maintain defences (W2-W4) until end of design life then implement phased cliff drainage and seawall stabilisation works (for example a mass rock revetment). Do minimum elsewhere.	£17,063	£8,167	£5,020	0.5
4	Improve (now)	Seawall stabilisation works (for example a mass rock revetment) and cliff stabilisation and drainage now (W2-W4). Do minimum elsewhere.	£25,498	£8,167	£5,020	0.3

Table 7-3: PV costs, PV benefits and cost-benefit ratio of the strategic options considered in SMZ 3a

SMZ 3a						
Strategic Option No.	**Strategic Option Name**	**Strategic Option Description**	**Cost to implement option (PV £k)**	**Benefit of option (PV £k)**	**Residual Damage of option (PV £k)**	**Benefit : Cost Ratio**
1	Do Nothing	No active intervention. Baseline scenario	£0	£0	£35,996	-
2	Do Minimum	H&S and access. Flood warning and emergency response plan.	£360	£233	£35,763	0.6
3	Maintain (and PLP) then Improve from 2055	Use Property Level Protection to manage and reduce flooding to residential properties at very significant risk. Prevent erosion to critical infrastructure serving the town and the West Wight. From 2055, if funding can be secured, raise / implement new defences (bunds and floodwalls) to manage long term increase in flood and erosion risk posed by sea level rise.	£6,366	£31,259	£4,736	4.9
4	Maintain (and Temporary Flood Barriers) then Improve from 2055	Use Temporary Flood Barriers to manage and reduce flooding to areas at significant risk by sustaining a 1 in 75 year (1.33% AEP) standard of protection. Prevent erosion to critical infrastructure serving the town and the West Wight. From 2055, if funding can be secured, raise / implement new defences (bunds and floodwalls) to manage long term increase in flood and	£6,560	£31,854	£4,142	4.9

		erosion risk posed by sea level rise.				
5	Improve (now)	Raise / implement new defences (bunds and floodwalls) to manage longer term increasing flood and erosion risk posed by sea level rise.	£25,263	£32,810	£3,186	1.3

Table 7-4: PV costs, PV benefits and cost-benefit ratio of the strategic options considered in SMZ 3b

SMZ 3b						
Strategic Option No.	**Strategic Option Name**	**Strategic Option Description**	**Cost to implement option (PV £k)**	**Benefit of option (PV £k)**	**Residual Damage of option (PV £k)**	**Benefit : Cost Ratio**
1	Do Nothing	No active intervention. Baseline scenario	£0	£0	£3,349	-
2	Do Minimum	H&S and access (minor repairs to cyclepath i.e. debris removal).	£88	£564	£2,784	6.4
3	Maintain	Maintenance of existing structures (including cycle path repairs) and refurbishment at end of design life.	£284	£781	£2,567	2.8
4	Do Minimum with Managed Realignment between 2025 and 2055	Maintain existing structures, H&S and cycle and footpath access. If funding can be secured, managed realignment at Thorley Brook between 2025 and 2055 to provide environmental mitigation and create intertidal habitat.	£3,824	£1,271	£2,077	0.3

*Preferred option driven by environmental requirements, not economics

Table 7-5: PV costs, PV benefits and cost-benefit ratio of the strategic options considered in SMZ 3c

SMZ 3c						
Strategic Option No.	**Strategic Option Name**	**Strategic Option Description**	**Cost to implement option (PV £k)**	**Benefit of option (PV £k)**	**Residual Damage of option (PV £k)**	**Benefit : Cost Ratio**
1	Do Nothing	No active intervention. Baseline scenario	£0	£0	£10,354	-
2	Do Minimum	H&S and access. Flood warning and emergency response plan.	£56	£269	£10,085	4.8
3	Adaption and Resilience (and PLP) / Do Minimum	Recommend Property Level Protection and flood warning / emergency response plan for residential properties at very significant risk.	£199	£1,538	£8,816	7.7
4	Maintain (and PLP) then Improve (2055)	Maintenance of existing structures and recommend Property Level Protection to the residential properties at significant flood risk. Refurbishment of existing defences at Freshwater Bay at end of design life to prevent erosion risk and implement new defences at Freshwater Village to mitigate flood risk and improve the standard of flood protection.	£1,450	£5,514	£4,839	3.8
5	Maintain and Improve (now)	Maintain existing defences at Freshwater Bay, improve standard of protection at Freshwater village. Refurbishment and Improve existing defences at end of design life at Freshwater Bay to mitigate erosion risk and implement new defences at Freshwater Village improve the standard of flood protection.	£1,708	£6,614	£3,739	3.9

Table 7-6: PV costs, PV benefits and cost-benefit ratio of the strategic options considered in SMZ 4

SMZ 4						
Strategic Option No.	**Strategic Option Name**	**Strategic Option Description**	**Cost to implement option (PV £k)**	**Benefit of option (PV £k)**	**Residual Damage of option (PV £k)**	**Benefit : Cost Ratio**
1	Do Nothing	No active intervention. Baseline scenario	£0	£0	£2,069	-

Table 7-7: PV costs, PV benefits and cost-benefit ratio of the strategic options considered in SMZ 5a

SMZ 5a						
Strategic Option No.	**Strategic Option Name**	**Strategic Option Description**	**Cost to implement option (PV £k)**	**Benefit of option (PV £k)**	**Residual Damage of option (PV £k)**	**Benefit : Cost Ratio**
1	Do Nothing	No active intervention. Baseline scenario	£0	£0	£6,340	-
2	Do Minimum, with community led adaption	Privately funded community and property level flood resilience and adaptation at Gurnard Luck (up to 2055). Private maintenance of existing assets permitted (subject to obtaining the required consents). In the longer term accept that flood risk will increase due to sea level rise but provide a Coastal Change Management Area Plan to support the No Active Intervention policy. Do Minimum (maintain health and safety) at Gurnard cliff.	£79	£354	£5,985	4.5
3	Improve (now) and then adapt	Improve to 1 in 75 year (1.33%) standard of protection through privately funded scheme involving parapet raising and setback walls and private maintenance of existing assets. In the longer term accept that flood risk will increase due to sea level rise but provide a Coastal Change Management Area Plan to support the No Active Intervention policy. Do Minimum (maintain health and safety) at Gurnard cliff.	£358	£1,873	£4,467	5.2
4	Maintain	Maintenance of existing structures and refurbishment at end of design life (and flood warning and emergency response plan). Accept flood risk will increase over time due to sea level rise. Do Minimum (maintain health and safety) at Gurnard cliff where there are no existing defences.	£759	£2,392	£3,947	3.2

Table 7-8: PV costs, PV benefits and cost-benefit ratio of the strategic options considered in SMZ 5b

SMZ 5b						
Strategic Option No.	**Strategic Option Name**	**Strategic Option Description**	**Cost to implement option (PV £k)**	**Benefit of option (PV £k)**	**Residual Damage of option (PV £k)**	**Benefit : Cost Ratio**
1	Do Nothing	No active intervention. Baseline scenario	£0	£0	£23,879	-
2	Do Minimum	Maintain H&S and access and also provide coastal change management area plan.	£259	£175	£23,704	0.7
3	Maintain	Maintenance of existing structures and refurbishment or replacement at end of their residual life to reduce risks of erosion and landslide reactivation.	£3,641	£23,551	£328	6.5
4	Improve (now).	Implement seawall stabilisation works along Cowes – Gurnard to reduce erosion risk and increase standard of flood protection	£16,408	£23,768	£111	1.4

Table 7-9: PV costs, PV benefits and cost-benefit ratio of the strategic options considered in SMZ 6a

SMZ 6a						
Strategic Option No.	**Strategic Option Name**	**Strategic Option Description**	**Cost to implement option (PV £k)**	**Benefit of option (PV £k)**	**Residual Damage of option (PV £k)**	**Benefit : Cost Ratio**
1	Do Nothing	No active intervention. Baseline scenario	£0	£0	£92,645	-
2	Do Minimum	Maintain H&S and access. Provide flood warning and emergency response plan.	£673	£2,080	£90,565	3.1
3	Do Minimum (and PLP) then Adapt	Recommend Property Level Protection for residential properties at very significant risk and maintain H&S and access. Adapt and provide flood warning / emergency response plan.	£1,704	£10,296	£82,348	6.0
4	Maintain	Maintenance of existing structures and refurbishment at end of design life. Accept standard of protection will fall over time.	£8,621	£24,760	£67,885	2.9
5	Sustain (with PLP) then Improve from 2055	In the short and medium term maintain the existing defences and use Property Level Protection and a flood warning / emergency response plan (no Temporary Flood Barriers) to manage and reduce flooding to residential properties at significant risk. Use redevelopment opportunities to facilitate the raising / implementation of new strategic defences. In the long term (from 2055), if the funding can be secured, implement new defences such as seawalls or setback floodwalls to manage the increase in flood and erosion risk posed by sea level rise.	£18,802	£49,231	£43,413	2.6

6	Sustain (with Temporary Flood Barriers and PLP) then Improve from 2055	In the short and medium term maintain the existing defences and use Temporary Flood Barriers and Property Level Protection to sustain a 1 in 75 year (1.33%) standard of protection in the areas at significant flood risk. Use redevelopment opportunities to facilitate the raising / implementation of new strategic defences. In the long term (from 2055), if the funding can be secured, implement new defences such as seawalls or setback floodwalls to manage the increase in flood and erosion risk posed by sea level rise.	£19,356	£57,006	£35,639	2.9
7	Improve (now)	Replace and raise defences to provide a 1 in 200 year (0.5% AEP) standard of flood protection.	£87,601	£92,203	£442	1.1

Table 7-10: PV costs, PV benefits and cost-benefit ratio of the strategic options considered in SMZ 6b

SMZ 6b						
Strategic Option No.	**Strategic Option Name**	**Strategic Option Description**	**Cost to implement option (PV £k)**	**Benefit of option (PV £k)**	**Residual Damage of option (PV £k)**	**Benefit : Cost Ratio**
1	Do Nothing*	No active intervention. Baseline scenario. (*W32 is Do Min. to 2055 – h&s of existing defences being allowed to fail).	£62	£0	£2,568	-
2	Do Minimum	Maintain H&S and access.	£122	£108	£2,459	0.9
3	Maintain	Maintenance of existing structures and refurbishment at end of design life. Accept standard of protection against flooding will fall over time due to sea level rise.	£1,293	£220	£2,348	0.2

Table 7-11: PV costs, PV benefits and cost-benefit ratio of the strategic options considered in SMZ 6c

SMZ 6c						
Strategic Option No.	**Strategic Option Name**	**Strategic Option Description**	**Cost to implement option (PV £k)**	**Benefit of option (PV £k)**	**Residual Damage of option (PV £k)**	**Benefit : Cost Ratio**
1	Do Nothing	No active intervention. Baseline scenario	£0	£0	£5,648	N/A
2	Do Minimum	Maintain H&S and access. Provide flood warning and emergency response plan.	£170	£94	£5,554	0.5
3	Maintain (and PLP) then Improve from 2055 (through redevelopment)	In the short term recommend Property Level Protection to manage and reduce flooding to the few residential properties at very significant risk. Maintain then refurbish existing defences once they reach the end of their service life. In the long term use redevelopment opportunities to facilitate the raising / implementation of new strategic defences to improve the standard of flood protection.	£1,932	£3,366	£2,282	1.7
4	Maintain (and PLP) then Improve from 2005 (through a frontline scheme)	In the short term recommend Property Level Protection to manage and reduce flooding to the few residential properties at very significant risk. Maintain then refurbish existing defences once they reach the end of their service life. A new frontline scheme from 2055 to improve the standard of flood protection.	£8,279	£4,707	£941	0.6
5	Improve (now)	Raise / implement new defences (bunds and floodwalls) now manage longer term increasing flood and erosion risk posed by sea level rise.	£26,861	£5,603	£46	0.2

8. Incremental Benefit-Cost Ratio

Typically in FCERM-AG, the Incremental Benefit Cost Ratio (IBCR) is a measure used to inform the cost-effectiveness of different standards of flood protection. It can be defined as the difference in cost between options with two different standards of protection, divided by the difference between their economic benefits. In the case of the Strategy, the standard of flood protection typically does not vary between the 'do something' options, rather, the options differ in terms of timing of works, the level of erosion protection provided and the provision of environmental benefits. Therefore, for the Strategy, the IBCR has been used to explore the cost effectiveness of more costly options in relation to the additional benefits that they may deliver.

To test the IBCR, firstly the options were ordered in terms of cost. The option with the highest Average Benefit Cost Ratio (ABCR) was then identified and recognised as the leading economic option. From here, the IBCR ratio of the next most expensive option was determined, and if greater than 1, indicated that the additional cost of the option provided a sufficient increase in benefits to be considered cost effective. If this was the case, this more costly option was then recognised as the leading economic option. This process was repeated until an IBCR of the next most costly option was less than 1. The leading economic option was selected on this basis.

The IBCR test was only undertaken when there were two or more options within an SMZ with an ABCR greater than 1 (hence, for some SMZs, the IBCR test was not performed).

Results are displayed in Table 8-1 to Table 8-6. Based upon the IBCR test the leading economic option for each SMZ is highlighted in red. The preferred option is also marked. It should be noted that the preferred option may not match the leading economic option; a number of additional factors contribute towards the selection of the preferred option, such as affordability and funding, technical considerations, wider strategy objectives and aspirations and environmental issues and opportunities.

Table 8-1: Incremental Benefit : Cost Ratios of strategic options considered in SMZ 3a

SMZ 3a - Incremental Benefit : Cost Ratio						
Strategic Option No.	**Strategic Option Name**	**Cost (PV £k)**	**Benefit (PV £k)**	**Residual Damage (PV £k)**	**Benefit : Cost Ratio**	**Incremental Benefit : Cost Ratio**
1	Do Nothing	£0	£0	£35,996	-	
2	Do Minimum	£360	£233	£35,763	0.6	
3	Maintain (and PLP) then Improve from 2055	£6,366	£31,259	£4,736	4.9	Highest ABCR
4 **(Preferred Option)**	Maintain (and Temporary Flood Barriers) then Improve from 2055	£6,560	£31,854	£4,142	4.9	3.1
5	Improve (now)	£25,263	£32,810	£3,186	1.3	0.1

Table 8-2: Incremental Benefit : Cost Ratios of strategic options considered in SMZ 3b

SMZ 3b - Incremental Benefit : Cost Ratio						
Strategic Option No.	**Strategic Option Name**	**Cost (PV £k)**	**Benefit (PV £k)**	**Residual Damage (PV £k)**	**Benefit : Cost Ratio**	**Incremental Benefit : Cost Ratio**
1	Do Nothing	£0	£0	£3,349	-	
2	Do Minimum	£88	£564	£2,784	6.4	Highest ABCR
3	Maintain	£284	£781	£2,567	2.8	1.1
4 **(Preferred Option)**	Do Minimum with Managed Realignment between 2025 and 2055	£3,824	£1,271	£2,077	0.3	0.1

*Preferred option driven by environmental requirements, not economics

Table 8-3: Incremental Benefit : Cost Ratios of strategic options considered in SMZ 3c

SMZ 3c - Incremental Benefit : Cost Ratio						
Strategic Option No.	**Strategic Option Name**	**Cost (PV £k)**	**Benefit (PV £k)**	**Residual Damage (PV £k)**	**Benefit : Cost Ratio**	**Incremental Benefit : Cost Ratio**
1	Do Nothing	£0	£0	£10,354	-	
2	Do Minimum	£56	£269	£10,085	4.8	
3	Adaption and Resilience (and PLP) / Do Minimum	£199	£1,538	£8,816	7.7	Highest ABCR
4 **(Preferred Option)**	Maintain (and PLP) then Improve (2055)	£1,450	£5,514	£4,839	3.8	3.2
5	Maintain and Improve (now)	£1,708	£6,614	£3,739	3.9	4.3

Table 8-4: Incremental Benefit : Cost Ratios of strategic options considered in SMZ 5a

SMZ 5a - Incremental Benefit : Cost Ratio						
Strategic Option No.	**Strategic Option Name**	**Cost (PV £k)**	**Benefit (PV £k)**	**Residual Damage (PV £k)**	**Benefit : Cost Ratio**	**Incremental Benefit : Cost Ratio**
1	Do Nothing	£0	£0	£6,340	-	
2 **(Preferred Option)**	Do Minimum, with community led adaption	£79	£354	£5,985	4.5	
3	Improve (now) and then adapt	£358	£1,873	£4,467	5.2	Highest ABCR
4	Maintain	£759	£2,392	£3,947	3.2	1.3

Table 8-5: Incremental Benefit : Cost Ratios of strategic options considered in SMZ 5b

SMZ 5a - Incremental Benefit : Cost Ratio						
Strategic Option No.	**Strategic Option Name**	**Cost (PV £k)**	**Benefit (PV £k)**	**Residual Damage (PV £k)**	**Benefit : Cost Ratio**	**Incremental Benefit : Cost Ratio**
1	Do Nothing	£0	£0	£23,879	-	
2	Do Minimum	£259	£175	£23,704	0.7	
3 **(Preferred Option)**	Maintain	£3,641	£23,551	£328	6.5	Highest ABCR
4	Improve (now).	£16,408	£23,768	£111	1.4	0.0

Table 8-6: Incremental Benefit : Cost Ratios of strategic options considered in SMZ 6a

SMZ 6a - Incremental Benefit : Cost Ratio						
Strategic Option No.	**Strategic Option Name**	**Cost (PV £k)**	**Benefit (PV £k)**	**Residual Damage (PV £k)**	**Benefit : Cost Ratio**	**Incremental Benefit : Cost Ratio**
1	Do Nothing	£0	£0	£92,645	-	
2	Do Minimum	£673	£2,080	£90,565	3.1	
3	Do Minimum (and PLP) then Adapt	£1,704	£10,296	£82,348	6.0	Highest ABCR
4	Maintain	£8,621	£24,760	£67,885	2.9	2.1

5	Sustain (with PLP) then Improve from 2055	£18,802	£49,231	£43,413	2.6	2.4
6 **(Preferred Option)**	Sustain (with Temporary Flood Barriers and PLP) then Improve from 2055	£19,356	£57,006	£35,639	2.9	14.0
7	Improve (now)	£87,601	£92,203	£442	1.1	0.5

As shown in Table 8-1 to Table 8-6, the IBCR changes the selection of the leading economic options in SMZs 3c, 5a and 6a. In these zones, there is an economic case to invest more money in higher cost options (i.e. the IBCR of the next most costly option above the option with the highest ABCR is greater than 1).

9. Preferred Options

The benefit:cost ratios, residual damages, and incremental benefits provided by highest cost options were used to evaluate and inform the selection of the preferred strategy management options. However, as previously outlined, selection of the preferred options was not based on economic grounds alone; a number of additional factors contribute towards the selection of the preferred option, such as affordability and funding, technical considerations, wider strategy objectives and aspirations and environmental issues and opportunities. Details of this approach can be found in Appendix J – Option Development and Appraisal. The preferred options are displayed in Table 9-1.

Table 9-1: The preferred strategic options identified at each SMZ

Preferred Strategic Options						
SMZ	**Preferred Strategic Option Name**	**Preferred Strategic Option Description** (requiring combinations of public and private funding)	**Cost (PV £k)**	**Benefit (PV £k)**	**Residual Damage (PV £k)**	**Benefit : Cost Ratio**
1	Do Nothing	No active intervention. Baseline scenario	£0	£0	£1,699	-
2	Do Minimum	Maintain H&S and access as long as possible and develop coastal change management area plan (W2-W6). W7 will be Do Nothing.	£308	£931	£12,256	3.0
3a	Maintain (and Temporary Flood Barriers) then Improve from 2055	Use Temporary Flood Barriers to manage and reduce flooding to areas at significant risk by sustaining 1 in 75 year (1.33% AEP) standard of protection. Prevent erosion to critical infrastructure serving the town and the West Wight. From 2055, if funding can be secured, raise / implement new defences (bunds and floodwalls) to manage long term increase in flood and erosion risk posed by sea level rise.	£6,560	£31,854	£4,142	4.9
3b	Do Minimum Managed Realignment between 2025 and 2055	Maintain existing structures, H&S and cycle and footpath access. If funding can be secured, managed realignment at Thorley Brook between 2025 and 2055 to provide environmental mitigation and create intertidal habitat.	£3,824	£1,271	£2,077	0.3
3c	Maintain and PLP then Improve (2055)	Maintenance of existing structures and recommend Property Level Protection to the residential properties at significant flood risk. Refurbishment of existing defences at Freshwater Bay at end of design life to prevent erosion risk and implement new defences at Freshwater Village to mitigate flood	£1,450	£5,514	£4,839	3.8

Preferred Strategic Options						
SMZ	**Preferred Strategic Option Name**	**Preferred Strategic Option Description** (requiring combinations of public and private funding)	**Cost (PV £k)**	**Benefit (PV £k)**	**Residual Damage (PV £k)**	**Benefit : Cost Ratio**
		risk and improve the standard of flood protection.				
4	Do Nothing	No active intervention. Baseline scenario	£0	£0	£2,069	-
5a	Do Minimum, with community led adaption	Privately funded community and property level flood resilience and adaptation at Gurnard Luck (up to 2055). Private maintenance of existing assets permitted (subject to obtaining the required consents). In the longer term accept that flood risk will increase due to sea level rise but provide a Coastal Change Management Area Plan to support the No Active Intervention policy. Do Minimum (maintain health and safety) at Gurnard cliff.	£79	£354	£5,985	4.5
5b	Maintain	Maintenance of existing structures and refurbishment or replacement at end of their residual life to reduce risks of erosion and landslide reactivation. Flood risk will increase due to sea level rise.	£3,641	£23,551	£328	6.5
6a	Sustain (with Temporary Flood Barriers and PLP) then Improve from 2055	In the short and medium term maintain the existing defences and use Temporary Flood Barriers and Property Level Protection to sustain a 1 in 75 year (1.33% AEP) standard of protection in the areas at significant flood risk. Use redevelopment opportunities to facilitate the raising / implementation of new strategic	£19,356	£57,006	£35,639	2.9

Preferred Strategic Options						
SMZ	**Preferred Strategic Option Name**	**Preferred Strategic Option Description** (requiring combinations of public and private funding)	**Cost (PV £k)**	**Benefit (PV £k)**	**Residual Damage (PV £k)**	**Benefit : Cost Ratio**
		defences. In the long term (from 2055), if the funding can be secured, implement new defences such as seawalls or setback floodwalls to manage the increase in flood and erosion risk posed by sea level rise.				
6b	Do Nothing	No active intervention. Baseline scenario. But, ensure h&s in W32 for first two epochs.	£62	£0	£2,568	-
6c	Maintain (and PLP) then Improve from 2055 (through redevelopment)	In the short term recommend Property Level Protection to manage and reduce flooding to the few residential properties at very significant risk. Maintain then refurbish existing defences once they reach the end of their service life. In the long term use redevelopment opportunities to facilitate the raising / implementation of new strategic defences to improve the standard of flood protection.	£1,932	£3,366	£2,282	1.7

10. Sensitivity Testing

A number of factors have been considered during the development of the preferred strategic options to ensure that each is robust against a wide range of sensitivities. These sensitivities include accelerated or reduced rates of sea level rise (discussed in section 10.1) and increased/decreased option costs (discussed in section 10.2).

10.1 Phased Management Approach

The Strategy has adopted the recommended UKCP09 medium emission scenario 95%tile (including surge factor) as the allowance for sea level rise. However, the large range of climate change scenarios evident in the UKCP09 estimates, it demonstrates the considerable uncertainty in future sea level rise predictions.

To accommodate this uncertainty into the Strategy, the preferred options incorporate a phased management approach whereby works are phased over time depending on risk based triggers. If for instance sea levels rise more slowly than anticipated, the phased approach allows decision makers to delay the implementation of new defences.

Conversely, should sea levels rise more rapidly than expected, defence implementation can be brought forward or the new defences can be built to a higher standard of protection. This approach therefore provides a great degree of flexibility, and allows time to monitor sea level rise to ensure maximum benefits are generated. It also avoids implementing works now which we could potentially 'regret' in the future because they were not needed.

This adaptive capacity of the Strategy and ability to be flexible ensures that the economic case remains sound despite the future uncertainty.

10.2 Option Costs – Optimism Bias

According to the HM Treasury Green Book, Optimism Bias should be applied to the costs of a scheme to account for:

- Capital costs
- Works duration
- Operating costs
- Under delivery of benefits

In line with FCERM-AG policy, an optimism bias of 60% was applied to the present value whole life costs for each strategic option, apart from the exceptions explained in Section 5.5. This level of optimism bias is in line with the current recommendations but it is advised that it should be adjusted if sufficient justification exists to do so.

Table 10-1 to Table 10-11 present the benefit cost ratios for the options with 30% larger or 30% smaller whole life option costs. The preferred options are shown in with a red box.

Table 10-1 to Table 10-10 demonstrate that when the estimated cost of options is increased by 30% the preferred options continue to have an average cost:benefit ratio of >1, apart from the Do Nothing options and the Thorley Brook Managed Realignment (3b) which is based on environmental drivers.

Table 10-1: Cost adjustment in SMZ 1

SMZ 1								
Strategic Option No.	Strategic Option Name	Benefit (PV £k)	Cost (PV £k)			Benefit : Cost Ratio		
			% change to costs			% change to costs		
			-30%	0%	+30%	-30%	0%	+30%
1	Do Nothing	£0	£0	£0	£0	-	-	-

Table 10-2: Cost adjustment in SMZ 2

SMZ 2								
Strategic Option No.	Strategic Option Name	Benefit (PV £k)	Cost (PV £k)			Benefit : Cost Ratio		
			% change to costs			% change to costs		
			-30%	0%	+30%	-30%	0%	+30%
1	Do Nothing	£0	£0	£0	£0	-	-	-
2	Do Minimum	£931	£237	£308	£400	3.9	3.0	2.3
3	Maintain then Improve from 2025	£8,167	£13,125	£17,063	£22,182	0.6	0.5	0.4
4	Improve (now)	£8,167	£19,614	£25,498	£33,148	0.4	0.3	0.2

Table 10-3: Cost adjustment in SMZ 3a

SMZ 3a								
Strategic Option No.	Strategic Option Name	Benefit (PV £k)	Cost (PV £k)			Benefit : Cost Ratio		
			% change to costs			% change to costs		
			-30%	0%	+30%	-30%	0%	+30%
1	Do Nothing	£0	£0	£0	£0	-	-	-
2	Do Minimum	£233	£277	£360	£468	0.8	0.6	0.5
3	Maintain (and PLP) then Improve from 2055	£31,259	£4,897	£6,366	£8,275	6.4	4.9	3.8
4	Maintain (and Temporary Flood Barriers) then Improve from 2055	£31,854	£5,046	£6,560	£8,528	6.3	4.9	3.7
5	Improve (now)	£32,810	£19,433	£25,263	£32,842	1.7	1.3	1.0

Table 10-4: Cost adjustment in SMZ 3b

SMZ 3b								
Strategic Option No.	Strategic Option Name	Benefit (PV £k)	Cost (PV £k)			Benefit : Cost Ratio		
			% change to costs			% change to costs		
			-30%	0%	+30%	-30%	0%	+30%
1	Do Nothing	£0	£0	£0	£0	-	-	-
2	Do Minimum	£564	£67	£88	£114	8.4	6.4	5.0
3	Maintain	£781	£218	£284	£369	3.6	2.8	2.1
4	Do Minimum with Thorley Brook Managed Realignment (from 2025)	£1,271	£2,942	£3,824	£4,971	0.4	0.3	0.3

*Preferred option driven by environmental requirements not economics.

Table 10-5: Cost adjustment in SMZ 3c

SMZ 3c								
Strategic Option No.	Strategic Option Name	Benefit (PV £k)	Cost (PV £k)			Benefit : Cost Ratio		
			% change to costs			% change to costs		
			-30%	0%	+30%	-30%	0%	+30%
1	Do Nothing	£0	£0	£0	£0	-	-	-
2	Do Minimum	£269	£43	£56	£73	6.2	4.8	3.7
3	Adaption and Resilience (PLP) / Do Minimum	£1,538	£153	£199	£259	10.0	7.7	5.9
4	Maintain (and PLP) then Improve in 2055	£5,514	£1,115	£1,450	£1,885	4.9	3.8	2.9
5	Maintain and Improve	£6,614	£1,314	£1,708	£2,220	5.0	3.9	3.0

Table 10-6: Cost adjustment in SMZ 4

SMZ 4								
Strategic Option No.	Strategic Option Name	Benefit (PV £k)	Cost (PV £k)			Benefit : Cost Ratio		
			% change to costs			% change to costs		
			-30%	0%	+30%	-30%	0%	+30%
1	Do Nothing	£0	£0	£0	£0	-	-	-

Table 10-7: Cost adjustment in SMZ 5a

SMZ 5a								
Strategic Option No.	Strategic Option Name	Benefit (PV £k)	Cost (PV £k)			Benefit : Cost Ratio		
			% change to costs			% change to costs		
			-30%	0%	+30%	-30%	0%	+30%
1	Do Nothing	£0	£0	£0	£0	-	-	-
2	Do Minimum, with community led adaption	£354	£61	£79	£103	5.8	4.5	3.4
3	Improve (now) and then adapt	£1,873	£276	£358	£466	6.8	5.2	4.0
4	Maintain	£2,392	£584	£759	£987	4.1	3.2	2.4

Table 10-8: Cost adjustment in SMZ 5b

SMZ 5b								
Strategic Option No.	Strategic Option Name	Benefit (PV £k)	Cost (PV £k)			Benefit : Cost Ratio		
			% change to costs			% change to costs		
			-30%	0%	+30%	-30%	0%	+30%
1	Do Nothing	£0	£0	£0	£0	-	-	-
2	Do Minimum	£175	£199	£259	£337	0.9	0.7	0.5
3	Maintain	£23,551	£2,801	£3,641	£4,734	8.4	6.5	5.0
4	Improve (now).	£23,768	£12,622	£16,408	£21,330	1.9	1.4	1.1

Table 10-9: Cost adjustment in SMZ 6a

SMZ 6a								
Strategic Option No.	Strategic Option Name	Benefit (PV £k)	Cost (PV £k)			Benefit : Cost Ratio		
			% change to costs			% change to costs		
			-30%	0%	+30%	-30%	0%	+30%
1	Do Nothing	£0	£0	£0	£0	-	-	-
2	Do Minimum	£2,080	£518	£673	£875	4.0	3.1	2.4
3	Do Minimum to Adaption and Resilience (PLP)	£10,296	£1,311	£1,704	£2,215	7.9	6.0	4.6
4	Maintain	£24,760	£6,631	£8,621	£11,207	3.7	2.9	2.2
5	Sustain (with PLP) then Improve from 2055	£49,231	£14,463	£18,802	£24,442	3.4	2.6	2.0
6	Sustain (with Temporary Flood Barriers and PLP) then Improve from 2055	£57,006	£14,890	£19,356	£25,163	3.8	2.9	2.3
7	Improve. Frontline wall now	£92,203	£67,386	£87,601	£113,882	1.4	1.1	0.8

Table 10-10: Cost adjustment in SMZ 6b

SMZ 6b								
Strategic Option No.	Strategic Option Name	Benefit (PV £k)	Cost (PV £k)			Benefit : Cost Ratio		
			% change to costs			% change to costs		
			-30%	0%	+30%	-30%	0%	+30%
1	Do Nothing	£0	£48	£62	£80	-	-	-
2	Do Minimum	£108	£94	£122	£158	1.2	0.9	0.7
3	Maintain	£220	£994	£1,293	£1,681	0.2	0.2	0.1

Table 10-11: Cost adjustment in SMZ 6c

SMZ 6c								
Strategic Option No.	Strategic Option Name	Benefit (PV £k)	Cost (PV £k)			Benefit : Cost Ratio		
			% change to costs			% change to costs		
			-30%	0%	+30%	-30%	0%	+30%
1	Do Nothing	£0	£0	£0	£0	-	-	-
2	Do Minimum	£94	£131	£170	£222	0.7	0.5	0.4
3	PLP and Maintain (improve through redevelopment)	£3,366	£1,486	£1,932	£2,511	2.3	1.7	1.3
4	PLP and resilience then Improve	£4,707	£6,369	£8,279	£10,763	0.7	0.6	0.4
5	Improve. Frontline wall now.	£5,603	£20,662	£26,861	£34,919	0.3	0.2	0.2

11. Priority Schemes and Partnership Funding Assessments

Priority Schemes

During the development of the strategy, the areas with the most significant flood risk and with the greatest need of additional coastal defence schemes within the next 10 years were identified. These are termed the 'priority schemes' and are discussed in more detail in this chapter. They are eligible for a proportion of Grant in Aid, and the Isle of Wight Council will actively seek the remaining funding for these schemes. Areas with significant risk where schemes are required from 15 years are also highlighted in this chapter.

In Cowes and East Cowes a scheme has been developed that proposes the use of Temporary Flood Barriers in various locations. To ensure funding efficiencies this scheme has been grouped with a similar scheme in Yarmouth which also uses Temporary flood barriers. These schemes precede the long term preferred strategic options of implementing new more substantial flood defences in these areas (which are not currently affordable). Alongside the temporary flood barriers in Cowes and East Cowes, another scheme which incorporates Property Level Protection in several additional locations has also been identified. These schemes are described below and maps of the schemes are presented in the following pages:

The priority schemes are (see maps in Figure 11-1 and 11-2):

- ***Cowes and East Cowes temporary flood barriers (areas A, B, C & D) and Yarmouth temporary flood barriers.*** Cowes (SMZ6a) and Yarmouth (SMZ3a) are at significant risk of flooding over the next century. In Cowes, by 2115, 423 properties are expected to be at risk of flooding during a 1:200 year flood event whereas in Yarmouth 77 properties are expected to be at risk. To reduce the risk in Cowes it is proposed that temporary flood barriers are supplied in four areas (A,B,C & D) before 2025. This scheme would benefit approximately 63 residential properties. In Yarmouth it is proposed that temporary flood barriers are also supplied before 2025, benefiting approximately 12 residential properties. Both schemes assume a 20 year design life. A number of commercial properties would also benefit from the provision of Temporary Barriers in each area.

- **Cowes and East Cowes property level protection (areas a,b,c).** To reduce the risk it is proposed property level protection for residential properties is supplied before 2025 (scheme then assumes a 20 year design life). This scheme would benefit approximately 34 residential properties.

- **Other areas of property level protection.** Other small areas have been identified as having localised residential properties at very significant flood risk in the short to medium term. Due to the isolated or small number of properties, notable changes in policy over time, or recent provision of flood grants to a number of properties, these are recommended to be privately funded, subject to any further opportunities to assess the economic case for government funding for these areas, and any opportunities to package together PLP schemes to create efficiencies. These areas are Freshwater village (the Causeway), Gurnard Luck and Newport harbour.

The funding and economics for the priority schemes are provided in Table 11-1.

Table 11-1. Priority schemes funding summary

Scheme	SMZ/ODU	Capital cost (£)	Maintenance cost (£)	Appraisal period assumed (yrs)	B:C	No. Properties benefitting	Raw PF score	Funding shortfall (£)	Potential GiA amount (£) assuming contributions to achieve 100% PF
Cowes & East Cowes property level protection (a,b,c)	**6a / W24, W25, W31**	**£267,200**	**£32,600**	**20**	**8.5**	**34**	**77%**	**£60,518**	**£206,712**
Temporary Barriers scheme in **Cowes, East Cowes (areas ABCD) and Yarmouth**	**6a and 3a / W16, W25, W31**	**£773,763**	**£151,118**	**20**	**10.8**	**75**	**75%**	**£191,108**	**£582,655**

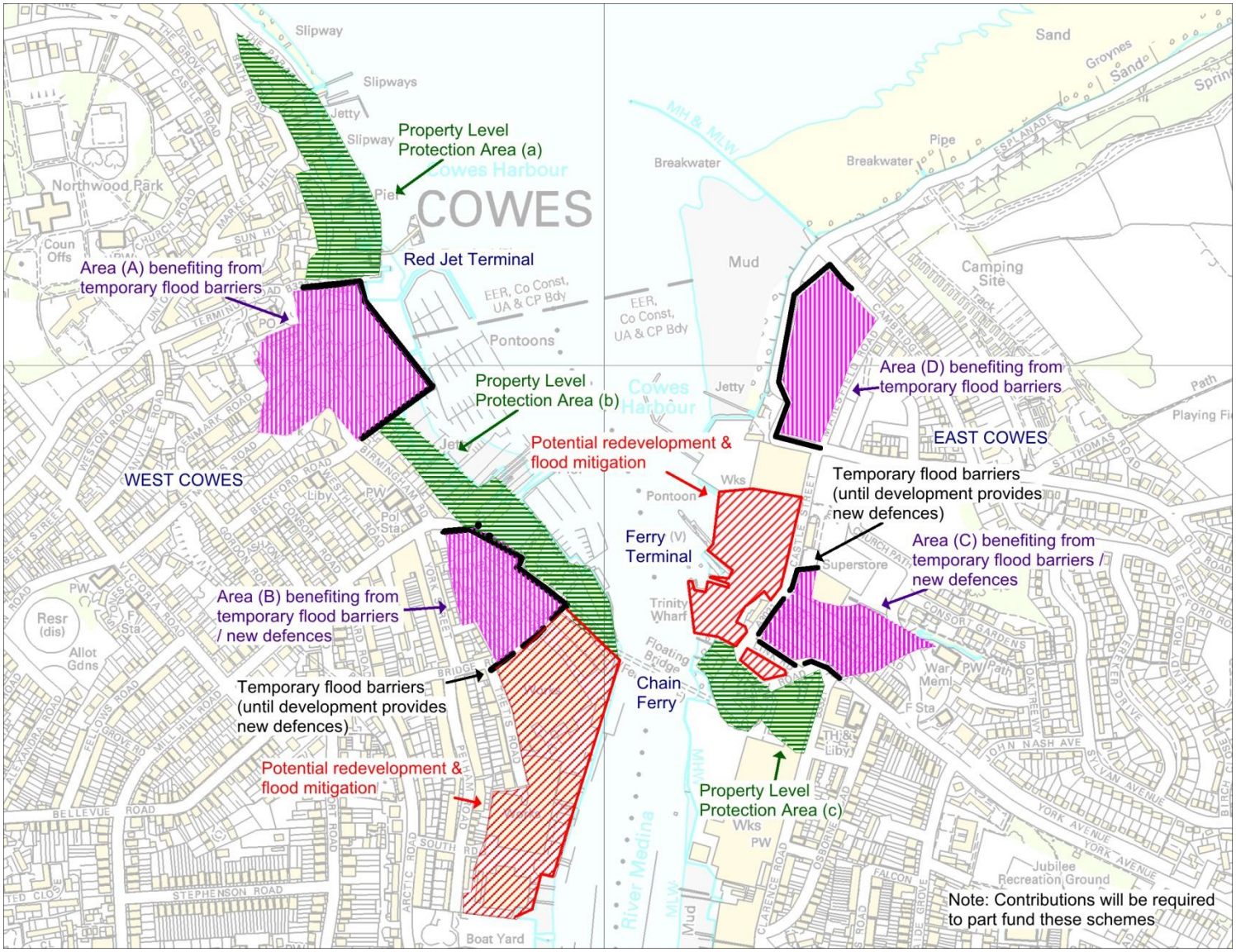

Figure 11-1: Map showing areas of Cowes temporary flood barrier and property level protection priority schemes

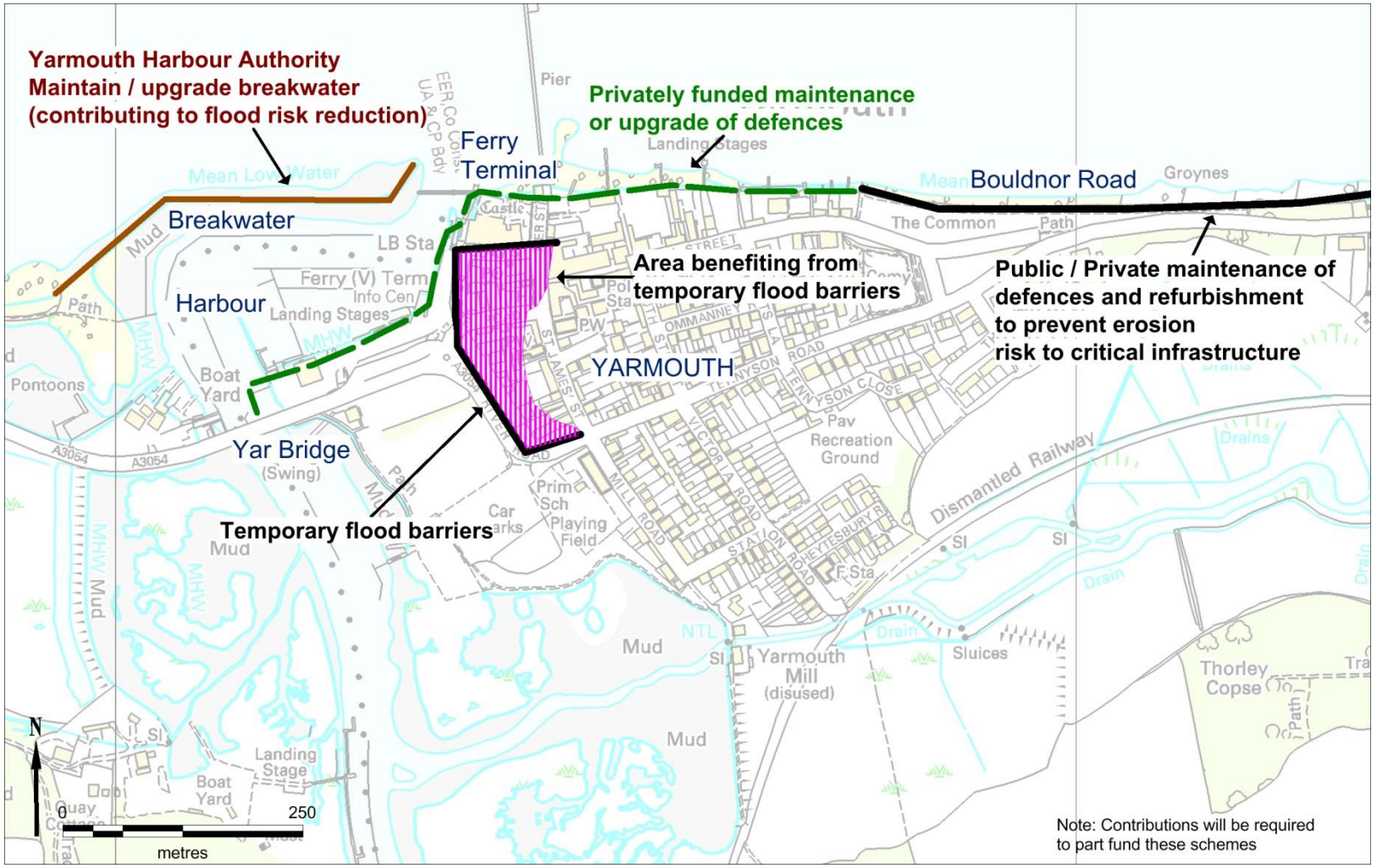

Figure 11-2: Map showing area of Yarmouth temporary flood barrier priority scheme

Epoch 2 Schemes

In addition to the priority schemes there are other key schemes which have been identified to be required early in epoch 2 (from 15 years' time). Due to funding limitations and affordability, the planned implementation of these schemes depends on whether the necessary contributions/additional funding can be acquired. Whilst it is the aspiration that these schemes are implemented as soon as possible, the schemes are likely to gain a proportion of Grant in Aid funding and therefore significant contributions will have to be raised in order to implement them. The following scheme descriptions assume that the scheme will be implemented in epoch 2, although it must be remembered that the funding case for the schemes is based on the current funding system that is likely to change in the future. The schemes identified from 15 years' time include:

- **Gurnard to Cowes refurbishment.** Gurnard to Cowes (SMZ5b) is at significant risk of erosion over the next century. In this area 269 properties are expected to be at risk of erosion over the next 100 years. Additionally, there are another approximately 250 properties at risk over the next 100 years because they are within the area of potential landslide reactivation under the developed coastal slopes. To reduce this risk it is proposed the existing seawall is refurbished when it reaches the end of its residual life (between 2025 and 2055). It is estimated this scheme would benefit approximately 89 residential properties (33 properties protected from coastal erosion and 56 protected from landsliding – using the linear approach described in Section 3.3.3). Implementing the scheme in 2030 scheme results in a raw PF score of 52% and a funding shortfall of approximately £1,346k to achieve a PF score of 100%.

- **Bouldnor Road refurbishment.** Bouldnor Road, along the Yarmouth Coast (SMZ3a) is at significant risk of erosion over the next century. If the existing seawall fails, it is predicted that in the short to medium term the Bouldnor Road would have to be closed due to erosion risks, severing an important strategic transport link on the Island. The preferred strategic approach is to maintain and refurbish the wall (810m) in front of the road. The refurbishment scheme has a PF score of 75% with approximately £291k funding required to achieve a score of 100%.

The funding and economics for the priority schemes are provided in Table 11-2.

Beyond the epoch 2, further works will be required in other areas (see Appendix 1), but being planned for so far into the future, detailed funding information is not provided in this report.

Table 11-2 Epoch 2 schemes funding summary

Scheme	SMZ / ODU	Capital cost (£)	Maintenance cost (£)	Appraisal period assumed (yrs)	B:C	No. Properties benefitting	Raw PF score	Funding shortfall (£)	Potential GiA amount (£) assuming contributions to achieve 100% PF
Gurnard to Cowes wall refurbishment	5b / W23	£2,800,000	£240,000	20	5.9	89	52%	£1,345,700	£1,454,300
Bouldnor Road wall refurbishment	3a / W17	£1,159,000	£78,000	20	13.5	NA	75%	£291,000	£868,000

Outcome Measures (OM) for Flood and Coastal Erosion Risk Management Grant in Aid (GiA) funding

There are four outcome measures under which projects can attract FCERM GiA. These are:

1. All benefits arising as a result of the investment, less than those valued under the other outcome measures (outcome measure 1).
2. Households moved from one category of flood risk to a lower category (outcome measure 2).
3. Households better protected against coastal erosion (outcome measure 3).
4. Statutory environmental obligations met through flood and erosion risk management (outcome measure 4).

Each of the four outcome measures is relevant to the Strategy. A full table of the outcome measures (OMs) and benefits under each that will qualify for national funding is provided in the latest DEFRA GiA guidance. The table is reproduced below in Table 11-3.

Table 11-3: Summary of outcome measures (DEFRA, 2011)

OM no.	Outcome Measure definition	Benefits and outcomes qualifying for national funding	Payment rate	Examples of funding levels from Government
OM1	Average benefit to cost ratio of schemes delivering OMs	Under OM1, present value of whole-life benefits of the current investment, less benefits paid for or payments made under the other outcome measures.	5.56p per £1 of qualifying benefit (i.e. seeking an 18 to 1 return from national investment)	These include avoidance of damages to e.g. business, agriculture, local government, communications, infrastructure, utilities and public health
OM 1a	*Present value of whole-life benefits per £1 of FCERM GiA*			
OM2	Households moved from one category of flood risk to a lower category *Households must be at direct risk of flood damage and have been built or converted into housing before January 2012 to be counted*	Under OM2, present value of direct damages to residential properties and their contents avoided, in the:		Based on moving a single household from a very significant risk to a low risk for a duration of 50 years
		-20% most deprived areas	45p per £1	£15,399 per household protected
		-21-40% most deprived areas	30p per £1	£10,266 per household protected
		-60% least deprived areas	20p per £1	£6,844 per household protected
OM3	Households better protected against coastal erosion *Households against must be direct risk of damage from coastal erosion and have been built or converted into housing before January 2012 to qualify*	Under OM3, present value of the reduction in direct damages to residential properties, in the:		Based on protecting a single household at risk of loss within 20 years, for a period of 50 years
		- 20% most deprived areas	45p per £1	£35,601 per household protected
		- 21-40% most deprived areas	30p per £1	£23, 734 per household protected
		- 60% least deprived areas	20p per £1	£15,822 per household protected
OM4	Statutory environmental obligations fully met through flood and coastal erosion risk management	Outcomes specifically funded under OM4:		
OM 4a	Hectares of water-dependent habitat created or improved to help meet the objectives of the Water Framework Directive	Water-dependent habitat created or improved	£15,000 per hectare	

OM no.	Outcome Measure definition	Benefits and outcomes qualifying for national funding	Payment rate	Examples of funding levels from Government
OM 4b	Hectares of inter-tidal habitat created to help meet the objectives of the Water Framework Directive for areas protected under the EA Habitats or Birds Directive	Inter-tidal habitat created	£50,000 per hectare	
OM 4c	Kilometers of river protected under the EU Habitats or Birds Directive improved to help meet the objectives of the Water Framework Directive	Protected rivers improved	£80,000 per km of river bed	

Table 11-4: Flood risk categories (DEFRA, 2011)

Risk category	Annual chance of flooding
Very significant	5% or greater 1in10
Significant risk	Greater than 1.33% (1in75) but less than 5%
Moderate risk	Greater than 0.5 % (1in200) but less than or equal to 1.3%
Low risk	0.5% or less

Grant in Aid (GiA) and the Partnership Funding (PF) calculator

Based upon the economic appraisal, the potential for FCERM GiA funding has been considered for the priority schemes and other schemes to be implemented in the Strategy listed above. The Environment Agency has prepared a standard spreadsheet/calculator (2014/2015 version) to calculate the level of GiA based on a series of input parameters.

It should be noted that the input parameters for the OM scoring consider the design life of the scheme and differ from the economics which require a 100 year appraisal period as part of the options appraisal process. In addition, the funding case for each scheme is based upon the scheme area only and not the entire ODU (i.e. properties that are in the same ODU, but fall outside of the scheme area are excluded from the funding assessment). In line with this approach, any costs that may arise outside of the scheme area and approach (i.e. maintenance costs for existing frontline defences within the same ODU) have been excluded from the scheme costs.

The scheme duration was defined from the year of construction to the year of replacement. The temporary flood barrier scheme and property level protection schemes in Cowes and the temporary flood barrier scheme in Yarmouth are due to be implemented between 2015 and 2025 are considered to have a design life of 20 years before requiring replacement. The Gurnard to Cowes and Bouldnor Road refurbishment schemes were also considered to have a 20 year design life.

The PV whole-life cost and PV whole-life benefits of the scheme were calculated by summing the relevant flood and erosion damages over the scheme duration.

To consider the households protected against flood risk over the duration of the investment, flood inundation mapping before and after scheme implementation was inspected to calculate the number of households within each flood risk category (as defined in Table 11-4). To complete the analysis and enable the level of deprivation to be considered in the OM score calculation, the Multiple Index for Deprivation Rank for each property was determined. These values are summarised in Table 11-5.

It should however be noted that the GiA funding criteria beyond 2015 is likely to be subject to change and if these schemes are delayed they results below will also change, this is especially relevant for the Cowes-Gurnard future scheme.

Table 11-5: Number of households, their respective flood risk and their score on the index of Multiple Deprivation (IMD)

	IMD <20%			20% ≤ IMD < 40%			IMD ≥ 40%			Total
Scheme	*Moderate flood risk*	*Significant flood risk*	*Very significant flood risk*	*Moderate flood risk*	*Significant flood risk*	*Very significant flood risk*	*Moderate flood risk*	*Significant flood risk*	*Very significant flood risk*	
Cowes property level protection (abc)	/	/	/	/	/	/	/	/	34	34
Cowes temporary flood barriers (ABCD) and Yarmouth temporary flood barriers	/	/	/	/	/	/	6	35	40	81

The EA partnership funding spreadsheet/calculator provides a GiA contribution (£) and an initial 'Raw' OM score which can be used to assess the likelihood of a scheme attracting partnership funding. The GiA contribution represents a theoretical maximum funding value that could be available based upon the outcomes delivered by the scheme. In some instances in the Strategy, this funding value actually exceeds the present value costs of the scheme. When this occurs it should be recognised that the funding value produced by the calculator would be capped at the full scheme cost. The 'Raw' OM score represents the percentage of GiA contribution compared to the PV costs of the scheme and therefore describes the proportion of the scheme cost that could be justified from Environment Agency national budgets (up to the limit of the full scheme cost). The calculator then considers any potential contributions secured against the project to develop a 'Partnership Funding' score.

The Defra policy statement puts forward a minimum OM threshold of 100% to receive national funding, but notes that any contributions secured towards projects scoring 100% or above can either a) reduce the cost of the scheme to the national taxpayer, making it more likely to go ahead sooner rather than later or b) be used to help fund other local schemes in the local strategy.

For example, a scheme with a strong benefit cost ratio and capital cost of £1million, achieving a raw OM score of 90%, could receive up to £900k in GiA with the remaining £100k coming from contributions to achieve at least the 100% target. If a private £200k contribution to this same scheme was available then it improves the OM score to 110%, and the GiA required funding could be reduced to £800k. In this example situation the likelihood of funding is higher if in competition with a similar project scoring only 100%.

For more details and definitions of each term used in the Partnership Funding calculator please refer to the Defra policy statement: *on an outcome-focused, partnership approach to funding flood and coastal erosion risk management* (2011).

11.1 Assessment of Cowes and East Cowes Property Level Protection (areas a,b,c) (priority scheme)

The priority scheme in Cowes consists of property level protection being supplied between 2015 and 2025 to residential properties at very significant risk, with a scheme design life of 20 years. Figure 11-3 shows potential locations of the PLP measures. Table 11-6 below presents a summary of the OM calculation and the full calculation sheet is included in Appendix 2. To take this scheme forward the Isle of Wight Council should apply for capital funding for this scheme.

The calculation shows that this scheme receives an OM score of 77%. This scheme would therefore require £61k contributions/funding partners to attract GiA funding, but if a 100% PF score was achieved GiA sum for approval would be £207k.

Note that this assumes that properties will be protected from significant risk events (1:75) as well as very significant risk events (1:20). This assumption has been made because much of the flooding at very significant risk is at a shallow flood depth, because there is little difference between the very significant and significant risk flood depths (approximately 12cm) it is thought that the solution would also protect against these events. Without also protecting against significant risk events the raw outcome measure score reduces to 66% and the external contributions required to achieve a PF score of 100% increases to £90,478.

Table 11-6: Summary of OM for Cowes property level protection (areas A,B,C)

Parameter	Value of FCERM GiA Contribution
Whole life PV costs including 60% optimism bias	£299,870
PV design and construction costs including 60% optimism bias	£267,230
OM 1 – Economic Benefit	£1,940,894
OM 2 – Households at risk from Flooding	£620,666
OM 3 – Households at risk from Erosion	£0
OM 4 – Statutory Environmental obligations met	£0
Total GiA Contribution	-
Raw Outcome Measure (OM) Score	77%
External Contributions (Private) Required (to achieve PF score of 100%)	£60,518
FDGiA Sum for Approval (towards upfront costs) assuming contributions to achieve 100% if required	£206,712

**note: OM1 refers to the total PV benefits of the option less benefits paid for or payments made under the other outcome measures*

11.2 Combined Temporary Barrier schemes: Assessment of Cowes temporary flood barriers (areas A,B,C,D) and Yarmouth temporary flood barriers (priority scheme)

The priority scheme in Cowes and Yarmouth consists of temporary flood barriers being supplied between 2015 and 2025, with a scheme design life of 20 years. This will provide at least a 1:75 year standard of protection. Figures 11-4 and 11-2 show the locations of the measures. In Cowes and East Cowes, Area A is 365m in length, area B is 340m, area C is 225m, area D is 380m In Yarmouth, 400m in length. The table below presents a summary of the OM calculation and the full calculation sheet is included in Appendix 2. To take this scheme forward the Isle of Wight Council should apply for capital funding for this scheme.

The calculation shows that this scheme receives an OM score of 75%. This scheme would therefore require £126k contributions/funding partners to attract GiA funding, but if a 100% PF score was achieved FDGiA sum for approval would be £648k.

Table 11-7: Summary of OM for Cowes temporary flood barriers (areas A,B,C,D) and Yarmouth temporary flood barriers

Parameter	Value of FCERM GiA Contribution
Whole life PV costs including 60% optimism bias	£924,881
PV design and construction costs including 60% optimism bias	£773,763
OM 1 – Economic Benefit	£9,044,831
OM 2 – Households at risk from Flooding	£969,791
OM 3 – Households at risk from Erosion	£0
OM 4 – Statutory Environmental obligations met	£0
Total GiA Contribution	-
Raw Outcome Measure (OM) Score	75%
External Contributions (Private) Required (to achieve PF score of 100%)	£191,108
FDGiA Sum for Approval (towards upfront costs) assuming contributions to achieve 100% if required	£582,655

**note: OM1 refers to the total PV benefits of the option less benefits paid for or payments made under the other outcome measures*

11.3 Assessment of Gurnard to Cowes refurbishment (epoch 2 scheme)

This other scheme consists of the 2.5km seawall between Gurnard and Cowes being refurbished at the end of its residual life to prevent erosion and landsliding occurring. The calculation assumes that the scheme will be implemented in 2030 although it is likely the government funding system will face changes before this time.

Table 11-8 below presents a summary of the OM calculation and the full calculation sheet is included in Appendix 2. To take this scheme forward the Isle of Wight Council should apply for capital funding for this scheme.

The calculation shows that this scheme receives an OM score of 52%. This scheme would therefore require £1,346,000k contributions/funding partners to attract GiA funding, but if a 100% PF score was achieved GiA sum for approval would be £1,214,800k.

Please see section 3.3.3 for further information on landslide damages.

Table 11-8: Summary of OM for Gurnard to Cowes refurbishment

Parameter	Value of FCERM GiA Contribution
Whole life PV costs including 60% optimism bias	£3,039,770
PV design and construction costs including 60% optimism bias	£2,800,000
OM 1 – Economic Benefit	£13,722,273
OM 2 – Households at risk from Flooding	£0
OM 3 – Households at risk from Erosion	£4,082,555
OM 4 – Statutory Environmental obligations met	£0
Total GiA Contribution	-
Raw Outcome Measure (OM) Score	52%
External Contributions (Private) Required (to achieve PF score of 100%)	£1,345,677
FDGiA Sum for Approval (towards upfront costs) assuming contributions to achieve 100% if required	£1,214,789

**note: OM1 refers to the total PV benefits of the option less benefits paid for or payments made under the other outcome measures*

11.4 Assessment of Bouldnor Road refurbishment (epoch 2 scheme)

This key scheme consists of the 810m seawall fronting Bouldnor Road being refurbished at the end of its residual life to prevent erosion of the important transport link and adjacent properties. The calculation assumes that the scheme will be implemented in 2030 although it is likely the government funding system will face changes before this time.

Table 11-8 below presents a summary of the OM calculation and the full calculation sheet is included in Appendix 2. To take this scheme forward the Isle of Wight Council should apply for capital funding for this scheme.

The calculation shows that this scheme receives an OM score of 75%. This scheme would therefore require £291,000 contributions/funding partners to attract GiA funding, but if a 100% PF score was achieved GiA sum for approval would be £868,000.

Please see section 3.4 for further information on transport damages.

Table 11-9: Summary of OM for Bouldnor Road refurbishment

Parameter	Value of FCERM GiA Contribution
Whole life PV costs including 60% optimism bias	£1,237,000
PV design and construction costs including 60% optimism bias	£1,159,000
OM 1 – Economic Benefit	£16,671,070
OM 2 – Households at risk from Flooding	£0
OM 3 – Households at risk from Erosion	£0
OM 4 – Statutory Environmental obligations met	£0
Total GiA Contribution	-
Raw Outcome Measure (OM) Score	75%
External Contributions (Private) Required (to achieve PF score of 100%)	£291,020
FDGiA Sum for Approval (towards upfront costs) assuming contributions to achieve 100% if required	£867,980

**note: OM1 refers to the total PV benefits of the option less benefits paid for or payments made under the other outcome measures*

12. References

Defra (2011) Flood and Coastal Resilience Partnership Funding: Defra policy statement on an outcome-focussed partnership approach to funding flood and coastal erosion risk management (May, 2011).

Environment Agency (2015) Cost estimation of coastal protection – summary of evidence (Report - SC080039/R7)

Flood and Coastal Erosion Risk Management appraisal guidance (Environment Agency, March 2010)

HM Treasury (2003) The Green Book: Appraisal and Evaluation in Central Government

Penning-Rowsell, Edmund Penning-Rowsell, Christophe Viavettene, Joana Pardoe, John Chatterton, Dennis Parker and Joe Morris (2013) The Benefits of Flood and Coastal Risk Management: A Handbook of Assessment Techniques. Flood Hazard Research Centre, Middlesex UK.

SPON's Civil Engineering and Highway works price book, Davis Langdon (2013)

Visit Isle of Wight (2014) Visitor statistics for the tourism year 2012/13 (prepared for Tourism South East)

Appendix 1 – Capital Works Cost Breakdown (Present Day Cash £) by SMZ for the Preferred Option Only Including Optimism Bias. Please note: schemes will need to be delivered at combined public and private cost.

Assumptions

The below tables are based on the following assumptions: do minimum and maintenance costs have been rounded to the nearest £100, capital works costs have been rounded to the nearest £100, refurbishment costs and costs of replacing temporary flood barriers are included in capital works, lengths are given to the nearest 10m, temporary flood barriers assumed to have a £2000 a year storage and deployment cost per area, refurbishment method costed assumed to last 20 years, after a new structure is constructed (i.e. frontline wall) it is assumed no maintenance had to occur for the first 20 years, costs are estimates that have been based on current unit rates and are likely to vary in the future, residual life estimates for existing structures are based on visual condition inspection and Environment Agency guidance.

SMZ1	2015 - 2025				2025 - 2055				2055 - 2115				*Cash Cost Summary £*			
	Works	Details	Cash Cost £		Works	Details	Cash Cost £		Works	Details	Cash Cost £		*Total Cost 2015 - 2025*	*Total Cost 2025 - 2055*	*Total Cost 2055 - 2115*	*Total Cost 2015 - 2115*
			Captial Works	Maintenance/ Do Minimum			Captial Works	Maintenance/ Do Minimum			Captial Works	Maintenance/ Do Minimum				
W1	Do Nothing	No active intervention. No planned works.	-	-	Do Nothing	No active intervention. No planned works.	-	-	Do Nothing	No active intervention. No planned works.	-	-	-	-	-	-
													Total Cost SMZ1 over 100 year Strategy period (2015 - 2115) =			-

SMZ2	2015 - 2025				2025 - 2055				2055 - 2115				*Cash Cost Summary £*			
	Works	Details	Cash Cost £		Works	Details	Cash Cost £		Works	Details	Cash Cost £		*Total Cost 2015 - 2025*	*Total Cost 2025 - 2055*	*Total Cost 2055 - 2115*	*Total Cost 2015 - 2115*
			Captial Works	Maintenance/ Do Minimum			Captial Works	Maintenance/ Do Minimum			Captial Works	Maintenance/ Do Minimum				
W2	Do Minimum	Access and health and safety at £2900 per year	-	£29,000	Do Minimum	Access and health and safety at £2900 per year and CCMA Plan	-	£103,000	Do Minimum	Access and health and safety at £2900 per year	-	£174,000	*£29,000*	*£103,000*	*£174,000*	*£306,000*
W3	Do Minimum	Access and health and safety at £1700 per year	-	£17,000	Do Minimum	Access and health and safety at £1700 per year and CCMA Plan	-	£67,000	Do Minimum	Access and health and safety at £1700 per year	-	£102,000	*£17,000*	*£67,000*	*£102,000*	*£186,000*
W4	Do Minimum	Access and health and safety at £1800 per year	-	£18,000	Do Minimum	Access and health and safety at £1800 per year and CCMA Plan	-	£70,000	Do Minimum	Access and health and safety at £1800 per year	-	£108,000	*£18,000*	*£70,000*	*£108,000*	*£196,000*
W5	Do Minimum	Access and health and safety at £300 per year	-	£3,000	Do Minimum	Access and health and safety at £300 per year and CCMA Plan	-	£25,000	Do Minimum	Access and health and safety at £300 per year	-	£18,000	*£3,000*	*£25,000*	*£18,000*	*£46,000*
W6	Do Minimum	Access and health and safety at £1700 per year	-	£17,000	Do Minimum	Access and health and safety at £1700 per year and CCMA Plan	-	£67,000	Do Minimum	Access and health and safety at £1700 per year	-	£102,000	*£17,000*	*£67,000*	*£102,000*	*£186,000*
W7	Do Nothing	No active intervention. No planned w orks.	-	-	Do Nothing	No active intervention. No planned w orks.	-	-	Do Nothing	No active intervention. No planned w orks.	-	-	*£0*	*£0*	*£0*	*£0*
													Total Cost SMZ2 over 100 year Strategy period (2015 - 2115) =			*£920,000*

SMZ3a	2015 - 2025				2025 - 2055				2055 - 2115				*Cash Cost Summary £*			
	Works	Details	Cash Cost £		Works	Details	Cash Cost £		Works	Details	Cash Cost £		*Total Cost 2015 - 2025*	*Total Cost 2025 - 2055*	*Total Cost 2055 - 2115*	*Total Cost 2015 - 2115*
			Captial Works	Maintenance/ Do Minimum			Captial Works	Maintenance/ Do Minimum			Captial Works	Maintenance/ Do Minimum				
W8	Do Minimum	Access and health and safety at £1900 per year	-	£19,000	Do Minimum	Access and health and safety at £3400 per year	-	£57,000	Do Minimum	Access and health and safety at £3400 per year	-	£114,000	*£19,000*	*£57,000*	*£114,000*	*£190,000*
W9	Maintain	Maintain existing structures at £4400 per year	-	£44,000	Maintain (& Refurb)	Maintain existing structures at £4400 per year, 680m refurbishment beginning from end of residual life (2035)	£598,000	£132,000	Maintain (& Refurb) and Frontline Defences	Maintain frontage, earth bunds or new walls to prevent erosion of road and improve flood standard of protection	£4,128,000	£176,000	*£44,000*	*£730,000*	*£4,304,000*	*£5,078,000*
W15	Maintain and Temporary Flood Barriers	Maintain existing structures at £4000 per year, 200m of temporary flood barriers	£82,000	£60,000	Maintain (& Refurb) and Temporary Flood Barriers	Maintain existing structures at £4000 per year - 610m refurbishment at end of residual life (2035), replace temporary flood barriers when required	£497,000	£180,000	Maintain (& Refurb) and Setback Defences	Maintain existing structures at £4000 per year - continued refurbishment. New 470m setback defences (flood bunds & gates).	£1,830,000	£300,000	*£142,000*	*£677,000*	*£2,130,000*	*£2,949,000*
W16	Maintain and Temporary Flood Barriers	Maintain existing structures at £5600 per year, 200m of temporary flood barriers	£82,000	£76,000	Maintain (& Refurb) and Temporary Flood Barriers	Maintain existing structures at £5600 per year - 860m refurbishment at end of residual life (2035), replace temporary flood barriers when required	£837,000	£228,000	Maintain (& Refurb), Frontline Wall and Setback Defences	Maintain existing structures at £5600 per year - continued refurbishment. New 270m Frontline Wall to north and 100m setback defences (flood wall & gates)	£7,946,000	£396,000	*£158,000*	*£1,065,000*	*£8,342,000*	*£9,565,000*
W17	Maintain	Maintain existing structures at £5300 per year	-	£53,000	Maintain (& Refurb)	Maintain existing structures at £5300 per year, 810m refurbishment at end of residual life (2025)	£2,268,000	£159,000	Maintain (& Refurb)	Maintain existing structures at £5300 per year, continued refurbishment	£2,268,000	£318,000	*£53,000*	*£2,427,000*	*£2,586,000*	*£5,066,000*
													Total Cost SMZ3a over 100 year Strategy period (2015 - 2115) =			*£22,848,000*

SMZ3b	2015 - 2025				2025 - 2055				2055 - 2115				Cash Cost Summary £			
	Works	Details	Cash Cost £		Works	Details	Cash Cost £		Works	Details	Cash Cost £		Total Cost 2015 - 2025	Total Cost 2025 - 2055	Total Cost 2055 - 2115	Total Cost 2015 - 2115
			Captial Works	Maintenance/ Do Minimum			Captial Works	Maintenance/ Do Minimum			Captial Works	Maintenance/ Do Minimum				
W10	Do Minimum	Access and health and safety at £300 per year	-	£3,000	Do Minimum	Access and health and safety at £300 per year	-	£9,000	Do Minimum	Access and health and safety at £300 per year	-	£18,000	£3,000	£9,000	£18,000	£30,000
W13	Do Minimum	Access and health and safety at £1900 per year	-	£19,000	Do Minimum	Access and health and safety at £1900 per year	-	£57,000	Do Minimum	Access and health and safety at £1900 per year	-	£114,000	£19,000	£57,000	£114,000	£190,000
W14	Maintain	Maintain existing structures at £1400 per year	-	£14,000	Managed Realignment	Managed Realignment would include new flood defences for property at increased risk	£5,300,000	£30,000	Maintain	Maintain new structures at £3000 per year	-	£180,000	£14,000	£5,330,000	£180,000	£5,524,000
													Total Cost SMZ3b over 100 year Strategy period (2015 - 2115) =			£5,744,000

SMZ3c	2015 - 2025				2025 - 2055				2055 - 2115				Cost Summary £			
	Works	Details	Cash Cost £		Works	Details	Cash Cost £		Works	Details	Cash Cost £		Total Cost 2015 - 2025	Total Cost 2025 - 2055	Total Cost 2055 - 2115	Total Cost 2015 - 2115
			Captial Works	Maintenance/ Do Minimum			Captial Works	Maintenance/ Do Minimum			Captial Works	Maintenance/ Do Minimum				
W11	Maintain, Property Level Protection and Flood Warning / Emergency Response Plan	Maintain existing structures at £750 per year, PLP for residential properties at very significant risk and flood warning / emergency response plan at £500 per year	£40,000	£12,500	Maintain (& Refurb) and Property Level Protection	Maintain existing structures at £750 per year - 115m refurbishment at end of residual life (2030), PLP for residential properties at very significant risk and flood warning / emergency response plan at £500 per year	£601,000	£37,500	Setback Defences	310m long	£1,360,000	£120,000	£52,500	£638,500	£1,480,000	£2,171,000
W12	Maintain	Maintain existing structures at £2000 per year	-	£20,000	Maintain (& Refurb)	Maintain existing structures at £2000 per year, 310m refurbishment at end of residual life (2025)	£838,000	£60,000	Maintain (& Refurb)	Maintain existing structures at £2000 per year, continued refurbishment	£838,000	£120,000	£20,000	£898,000	£958,000	£1,876,000
													Total Cost SMZ3c over 100 year Strategy period (2015 - 2115) =			£4,047,000

SMZ4	2015 - 2025				2025 - 2055				2055 - 2115				Cash Cost Summary £			
	Works	Details	Cash Cost £		Works	Details	Cash Cost £		Works	Details	Cash Cost £		*Total Cost 2015 - 2025*	*Total Cost 2025 - 2055*	*Total Cost 2055 - 2115*	*Total Cost 2015 - 2115*
			Captial Works	Maintenance/ Do Minimum			Captial Works	Maintenance/ Do Minimum			Captial Works	Maintenance/ Do Minimum				
W18	Do Nothing	No active intervention. No planned works.	-	-	Do Nothing	No active intervention. No planned works.	-	-	Do Nothing	No active intervention. No planned works.	-	-	-	-	-	-
W19	Do Nothing	No active intervention. No planned works.	-	-	Do Nothing	No active intervention. No planned works.	-	-	Do Nothing	No active intervention. No planned works.	-	-	-	-	-	-
W20	Do Nothing	No active intervention. No planned works.	-	-	Do Nothing	No active intervention. No planned works.	-	-	Do Nothing	No active intervention. No planned works.	-	-	-	-	-	-
													Total Cost SMZ4 over 100 year Strategy period (2015 - 2115) =			-

SMZ5a	2015 - 2025				2025 - 2055				2055 - 2115				Cash Cost Summary £			
	Works	Details	Cash Cost £		Works	Details	Cash Cost £		Works	Details	Cash Cost £		*Total Cost 2015 - 2025*	*Total Cost 2025 - 2055*	*Total Cost 2055 - 2115*	*Total Cost 2015 - 2115*
			Captial Works	Maintenance/ Do Minimum			Captial Works	Maintenance/ Do Minimum			Captial Works	Maintenance/ Do Minimum				
W21	Do Minimum and Flood Warning / Emergency Response Plan	Access and health and safety at £1700 per year and flood warning / emergency response plan at £500 per year	-	£22,000	Do Minimum and Flood Warning / Emergency Response Plan and Adaption	Access and health and safety at £1700 per year and flood warning / emergency response plan at £500 per year, development and implementation of CCMA Plan	-	£82,000	Do Minimum / Adaption	Access and health and safety at £1700 per year, flood warning / emergency response plan at £500 per year and implementation of CCMA Plan	-	£132,000	*£22,000*	*£82,000*	*£132,000*	*£236,000*
W22	Do Minimum	Access and health and safety at £300 per year	-	£3,000	Do Minimum	Access and health and safety at £300 per year	-	£9,000	Do Minimum	Access and health and safety at £300 per year	-	£18,000	*£3,000*	*£9,000*	*£18,000*	*£30,000*
													Total Cost SMZ5a over 100 year Strategy period (2015 - 2115) =			*£266,000*

SMZ5b	2015 - 2025				2025 - 2055				2055 - 2115				Cash Cost Summary £			
	Works	Details	Cash Cost £		Works	Details	Cash Cost £		Works	Details	Cash Cost £		Total Cost 2015 - 2025	Total Cost 2025 - 2055	Total Cost 2055 - 2115	Total Cost 2015 - 2115
			Captial Works	Maintenance/ Do Minimum			Captial Works	Maintenance/ Do Minimum			Captial Works	Maintenance/ Do Minimum				
W23	Maintain	Maintain existing structures at £16300 per year	-	£163,000	Maintain (& Refurb)	Maintain existing structures at £16300 per year, 2.5km refurbishment at end of residual life (2030)	£5,400,000	£489,000	Maintain (& Refurb)	Maintain existing structures at £16300 per year, continued refurbishment	£5,400,000	£978,000	*£163,000*	*£5,889,000*	*£6,378,000*	*£12,430,000*
													Total Cost SMZ5b over 100 year Strategy period (2015 - 2115) =			*£12,430,000*

SMZ6a	2015 - 2025				2025 - 2055				2055 - 2115				Cash Cost Summary £			
	Works	Details	Cash Cost £		Works	Details	Cash Cost £		Works	Details	Cash Cost £		Total Cost 2015 - 2025	Total Cost 2025 - 2055	Total Cost 2055 - 2115	Total Cost 2015 - 2115
			Captial Works	Maintenance/ Do Minimum			Captial Works	Maintenance/ Do Minimum			Captial Works	Maintenance/ Do Minimum				
W24	Maintain and Property Level Protection	Maintain existing structures at £2800 per year, PLP for residential properties at very significant risk	£40,000	£28,000	Maintain (& Refurb) and Property Level Protection	Maintain existing structures at £2800 per year - 435m refurbishment at end of residual life (2035), replace PLP when required	£502,000	£84,000	Frontline Wall	300m long	£6,192,000	£112,000	*£68,000*	*£586,000*	*£6,304,000*	*£6,958,000*
W25	Maintain, Temporary Flood Barriers and Property Level Protection	Maintain existing structures at £21800 per year, PLP for residential properties at very significant risk and 700m of temporary flood barriers	£350,000	£258,000	Maintain (& Refurb), Temporary Flood Barriers and Property Level Protection	Maintain existing structures at £21800 per year - 3.3km refurbishment at end of residual life (2035), replace PLP and temporary flood barriers when required	£3,558,000	£774,000	Frontline Wall and Setback Defences	1000m long	£20,640,000	£872,000	*£608,000*	*£4,332,000*	*£21,512,000*	*£26,452,000*
W31	Maintain, Temporary Flood Barriers and Property Level Protection	Maintain existing structures at £19600 per year, PLP for residential properties at very significant risk and 600m of temporary flood barriers	£311,000	£236,000	Maintain (& Refurb), Temporary Flood Barriers and Property Level Protection	Maintain existing structures at £19600 per year - 3.0km refurbishment at end of residual life (2035), replace PLP and temporary flood barriers when required	£3,446,000	£708,000	Frontline Wall and Setback Defences	1200m long	£24,768,000	£784,000	*£547,000*	*£4,154,000*	*£25,552,000*	*£30,253,000*
													Total Cost SMZ6a over 100 year Strategy period (2015 - 2115) =			*£63,663,000*

SMZ6b	2015 - 2025				2025 - 2055				2055 - 2115				Cash Cost Summary £			
	Works	Details	Cash Cost £		Works	Details	Cash Cost £		Works	Details	Cash Cost £		Total Cost 2015 - 2025	Total Cost 2025 - 2055	Total Cost 2055 - 2115	Total Cost 2015 - 2115
			Captial Works	Maintenance/ Do Minimum			Captial Works	Maintenance/ Do Minimum			Captial Works	Maintenance/ Do Minimum				
W26	Do Nothing	No active intervention. No planned works.	-	-	Do Nothing	No active intervention. No planned works.	-	-	Do Nothing	No active intervention. No planned works.	-	-	-	-	-	-
W27	Do Nothing	No publically funded defence improvements.	-	-	Do Nothing	No publically funded defence improvements.	-	-	Do Nothing	No publically funded defence improvements.	-	-	-	-	-	-
W28	Do Nothing	No active intervention. No planned works.	-	-	Do Nothing	No active intervention. No planned works.	-	-	Do Nothing	No active intervention. No planned works.	-	-	-	-	-	-
W30	Do Nothing	No active intervention. No planned works.	-	-	Do Nothing	No active intervention. No planned works.	-	-	Do Nothing	No active intervention. No planned works.	-	-	-	-	-	-
W32	Do Minimum	Access and health and safety at £2800 per year	-	£28,000	Do Minimum	Access and health and safety at £2800 per year	-	£84,000	Do Nothing	No active intervention. No planned works.	-	-	*£28,000*	*£84,000*	*£0*	*£112,000*
													Total Cost SMZ6b over 100 year Strategy period (2015 - 2115) =			*£112,000*

SMZ6c	2015 - 2025				2025 - 2055				2055 - 2115				Cash Cost Summary £			
	Works	Details	Cash Cost £		Works	Details	Cash Cost £		Works	Details	Cash Cost £		Total Cost 2015 - 2025	Total Cost 2025 - 2055	Total Cost 2055 - 2115	Total Cost 2015 - 2115
			Captial Works	Maintenance/ Do Minimum			Captial Works	Maintenance/ Do Minimum			Captial Works	Maintenance/ Do Minimum				
W29	Maintain, Property Level Protection and Flood Warning / Emergency Response Plan	Maintain existing structures at £10400 per year, PLP for residential properties at very significant risk and flood warning / emergency response plan at £500 per year	£30,000	£109,000	Maintain (& Refurb) and Property Level Protection	Maintain existing structures at £10400 per year - 1.6km refurbishment at end of residual life (2040), PLP for residential properties at very significant risk and flood warning / emergency response plan at £500 per year	£1,655,000	£327,000	Maintain (& Refurb) and Property Level Protection	Maintain existing structures at £10400 per year - continued refurbishment, PLP for residential properties at very significant risk and flood warning / emergency response plan at £500 per year	£5,030,000	£654,000	*£139,000*	*£1,982,000*	*£5,684,000*	*£7,805,000*
													Total Cost SMZ6c over 100 year Strategy period (2015 - 2115) =			*£7,805,000*

Total Cost of all SMZs over 100 year Strategy period (2015 - 2115) =	*£117,835,000*

Appendix 2 – FCERM GIA Priority Scheme Calculation Sheets

Cowes & East Cowes property level protection (a,b,c)

FCRM Partnership Funding Calculator for Flood and Coastal Erosion Risk Management Grant in Aid (FCRM GiA)
Version 8 January 2014

Project Name WW Strategy - Cowes PLP Areas ABC
Unique Project Number

Key: Input cells / Calculated cells

All figures are in £'s
Figures in Blue to be entered onto Medium Term Plan

SUMMARY: prospect of FCRM GiA funding

	Scheme Benefit to Cost Ratio:	8.54 to 1
	Effective return to taxpayer:	8.54 to 1
Raw Partnership Funding Score	77% (1)	*Effective return on contributions:* n/a to 1
External Contribution or saving required to achieve an Adjusted Score of 100%	60,518 (2)	
Adjusted Partnership Funding Score (PF)	77% (3)	
PV FCERM GiA towards the up-front costs of this scheme (PV Cost for Approval)	- (4)	

Cell (2) shows the minimum amount of contributions and/or reductions in scheme cost that are required to raise the Adjusted PF Score to at least 100%. Further increases on this will improve this scheme's chances of an FCRM GiA allocation in the desired year. Planned savings and contributions should be entered into cells(9,10,12) and cells(14-17). See NOTE below.

1. Scheme details

Risk Management Authority type of asset maintainer	LA (5)	Yes (6)
Duration of Benefits (years)	20 (7)	
PV Whole-Life Benefits:	2,561,560 (8)	

Is evidence available that a Strategic Approach has been taken, and that double counting of benefits has been avoided ?

All costs and benefits must be on a Present Value (PV) Whole-Life basis over the Duration of Benefits period. Where Contributions are identified these should also be on a Present Value basis.

PV Costs	
PV Appraisal Costs	42,500 (9)
PV design & Construction Costs	224,730 (10)
Sub Total - PV Cost for Approval (appraisal,design,construction)	**267,230** (11)
PV Post-Construction Costs	32,640 (12)
PV Whole-Life Costs:	299,870 (13)

The total value of any necessary contributions will depend on whether maintenance (ongoing costs) is funded through revenue FCRM GiA, or by other means.

NOTE: This scheme is to be maintained by an RMA other than the EA (ref cell 5). Capital FCRM GiA will fund the appropriate share of the up-front costs (cell 11) with any shortfall needing to be paid for via contributions identified in cells(14-17). Future ongoing costs (cell 12) and any contriubutions towards them are a matter for local agreement by the RMA and should NOT be included in cells(14-17). It is recommended that the RMA takes the opportunities created during scheme development to separately secure contributions towards future ongoing costs (cell12).

PV Contributions secured to date		
PV Local Levy secured to date		(14)
PV Public Contributions secured to date		(15)
PV Private Contributions secured to date		(16)
PV Funding form other Environment Agency functions/sources secured to date		(17)
PV Total Contributions secured to date	0	(18)

WARNING: Contributions less than minimum required in cell (2)

2. Qualifying benefits under Outcome Measure 2: households better protected against flood risk

Number of households in:	Before			After			Change due to scheme		
20% most deprived areas				-	-	-	0	0	0
21-40% most deprived areas				-	-	-	0	0	0
60% least deprived areas			34	34	-	-	34	0	-34
At:	Moderate risk	Significant risk	Very significant risk	Moderate risk	Significant risk	Very significant risk	Moderate risk	Significant risk	Very significant risk
Annual damages avoided (£), compared with a household at low risk							150	600	1,350

Change in household damages, in:	Per year	Over lifetime of scheme	Qual. benefits (discounted)	
20% most deprived areas	£ -	£ -	OM2 (20%)	£ -
21-40% most deprived areas	£ -	£ -	OM2 (21-40%)	£ -
60% least deprived areas	-£ 40,800	-£ 816,000	OM2 (60%)	£ 620,666

3. Qualifying benefits under Outcome Measure 3: households better protected against coastal erosion

Number of households in:	Before		Damages per household avoided:		
20% most deprived areas			Annual damages avoided	£ 6,000	£ 6,000
21-40% most deprived areas			Loss expected in	50	20 years
60% least deprived areas			Present value of Year 1 loss (i.e. first year damages, discounted based on when loss is expected)	£ 1,184	£ 3,015
	Long-term loss	Medium-term loss		Long-term loss	Medium-term loss

Change in household damages, in:	Year 1 loss avoided:	Over lifetime of scheme:	Qual. benefits (discounted):	
20% most deprived areas	£ -	£ -	OM3 (20%)	£ -
21-40% most deprived areas	£ -	£ -	OM3 (21-40%)	£ -
60% least deprived areas	£ -	£ -	OM3 (60%)	£ -

4. Qualifying benefits under Outcome Measure 4: statutory environmental obligations met

Payments under:			Assumed benefits per unit:	Qual. benefits (discounted):	
OM4a		Hectares of net water-dependent habitat created	£ 15,000	OM4a	£ -
OM4b		Hectares of net intertidal habitat created	£ 50,000	OM4b	£ -
OM4c		Kilometres of protected river improved	£ 80,000	OM4c	£ -
				OM4	**£ -**

5. Qualifying benefits arising from the overall scheme, for entry into the Medium-Term Plan

OM, deprivation:		Qual. benefits:	Payment rate:	FCRM GiA contribution:
OM1		£ 1,940,894	5.56 p in the £1	£ 107,827
OM2	20% most	£ -	45.0	£ -
	21-40%	£ -	30.0	£ -
	Least 60%	£ 620,666	20.0	£ 124,133
OM3	20% most	£ -	45.0	£ -
	21-40%	£ -	30.0	£ -
	Least 60%	£ -	20.0	£ -
OM4		£ -	100.0	£ -
Total		£ 2,561,560		**£ 231,961**

Maximum for Outcomes delivered. The actual value any scheme is elligible for may be less.

Sensitivity Testing. *It is important that users of this calculator appreciate the implications on funding from changes to input data which may become necessary as the project develops and better information is available. Five typical tests are provided below. Users should consider how appropriate these are to their project, what other tests may be appropriate and how best to use the information with all those that may be involved in the project.*

	Raw Score	Contribution for 100% Score (£k)
As scenario above	77%	60,518
Sensitivity 1 - Change in PV Whole Life Cost (25% increase)	77%	75,647
Sensitivity 2 - Change in OM2 - 50% of households in Very Significant (Before) risk may already be in Significant Risk band	68%	85,484
Sensitivity 3 - Change in OM3 - 50% of households in Medium Term loss (Before) may already be in Long Term loss	77%	60,518
Sensitivity 4 - Increase Duration of Benefits by 25%	48%	140,108
Sensitivity 5 - Reduce Duration of Benefits by 25%	72%	74,671

END OF WORKSHEET

CAPITA | AECOM

Combined Temporary Barriers scheme option: Cowes temporary flood barriers (ABCD) and Yarmouth temporary flood barriers

FCRM Partnership Funding Calculator for Flood and Coastal Erosion Risk Management Grant in Aid (FCRM GiA)
Version 8 January 2014

Project Name	WW Strategy - Temporary Flood Barriers A,B,C,D and Yarmouth
Unique Project Number	

Key: Input cells / Calculated cells

All figures are in £'s
Figures in Blue to be entered onto Medium Term Plan

SUMMARY: prospect of FCRM GiA funding

		Scheme Benefit to Cost Ratio:	10.83 to 1
		Effective return to taxpayer:	10.83 to 1
Raw Partnership Funding Score	75% (1)	*Effective return on contributions:*	n/a to 1
External Contribution or saving required to achieve an Adjusted Score of 100%	191,108 (2)		
Adjusted Partnership Funding Score (PF)	75% (3)		
PV FCERM GiA towards the up-front costs of this scheme (PV Cost for Approval)	- (4)		

Cell (2) shows the minimum amount of contributions and/or reductions in scheme cost that are required to raise the Adjusted PF Score to at least 100%. Further increases on this will improve this scheme's chances of an FCRM GiA allocation in the desired year. Planned savings and contributions should be entered into cells(9,10,12) and cells(14-17). See NOTE below.

1. Scheme details

Risk Management Authority type of asset maintainer	LA (5)	Yes (6)
Duration of Benefits (years)	20 (7)	
PV Whole-Life Benefits:	10,014,621 (8)	

Is evidence available that a Strategic Approach has been taken, and that double counting of benefits has been avoided ?

All costs and benefits must be on a Present Value (PV) Whole-Life basis over the Duration of Benefits period. Where Contributions are identified these should also be on a Present Value basis.

PV Costs	
PV Appraisal Costs	25,000 (9)
PV design & Construction Costs	748,763 (10)
Sub Total - PV Cost for Approval (appraisal,design,construction)	**773,763** (11)
PV Post-Construction Costs	151,118 (12)
PV Whole-Life Costs:	924,881 (13)

The total value of any necessary contributions will depend on whether maintenance (ongoing costs) is funded through revenue FCRM GiA, or by other means.

PV Contributions secured to date	
PV Local Levy secured to date	(14)
PV Public Contributions secured to date	(15)
PV Private Contributions secured to date	(16)
PV Funding form other Environment Agency functions/sources secured to date	(17)
PV Total Contributions secured to date	0 (18)
WARNING: Contributions less than minimum required in cell (2)	

NOTE: This scheme is to be maintained by an RMA other than the EA (ref cell 5). Capital FCRM GiA will fund the appropriate share of the up-front costs (cell 11) with any shortfall needing to be paid for via contributions identified in cells(14-17). Future ongoing costs (cell 12) and any contriubutions towards them are a matter for local agreement by the RMA and should NOT be included in cells(14-17). It is recommended that the RMA takes the opportunities created during scheme development to separately secure contributions towards future ongoing costs (cell12).

2. Qualifying benefits under Outcome Measure 2: households better protected against flood risk

Number of households in:	Before			After			Change due to scheme		
20% most deprived areas				-	-	-	0	0	0
21-40% most deprived areas				-	-	-	0	0	0
60% least deprived areas				81	-	-	75	-35	-40
At:	Moderate risk	Significant risk	Very significant risk	Moderate risk	Significant risk	Very significant risk	Moderate risk	Significant risk	Very significant risk
	6	35	40						

Annual damages avoided (£), compared with a household at low risk: 150 | 600 | 1,350

Change in household damages, in:	Per year	Over lifetime of scheme	Qual. benefits (discounted)
20% most deprived areas	£ -	£ -	OM2 (20%) £ -
21-40% most deprived areas	£ -	£ -	OM2 (21-40%) £ -
60% least deprived areas	-£ 63,750	-£ 1,275,000	OM2 (60%) £ 969,791

3. Qualifying benefits under Outcome Measure 3: households better protected against coastal erosion

Number of households in:	Before	
20% most deprived areas		
21-40% most deprived areas		
60% least deprived areas		
	Long-term loss	Medium-term loss

Damages per household avoided:

	Long-term loss	Medium-term loss
Annual damages avoided	£ 6,000	£ 6,000
Loss expected in	50	20 years
Present value of Year 1 loss (i.e. first year damages, discounted based on when loss is expected)	£ 1,184	£ 3,015

Change in household damages, in:	Year 1 loss avoided:	Over lifetime of scheme:	Qual. benefits (discounted):
20% most deprived areas	£ -	£ -	OM3 (20%) £ -
21-40% most deprived areas	£ -	£ -	OM3 (21-40%) £ -
60% least deprived areas	£ -	£ -	OM3 (60%) £ -

4. Qualifying benefits under Outcome Measure 4: statutory environmental obligations met

Payments under:			Assumed benefits per unit:	Qual. benefits (discounted):
OM4a		Hectares of net water-dependent habitat created	£ 15,000	OM4a £ -
OM4b		Hectares of net intertidal habitat created	£ 50,000	OM4b £ -
OM4c		Kilometres of protected river improved	£ 80,000	OM4c £ -
				OM4 £ -

5. Qualifying benefits arising from the overall scheme, for entry into the Medium-Term Plan

OM, deprivation:		Qual. benefits:	Payment rate:		FCRM GiA contribution:
OM1		£ 9,044,831	5.56	p in the £1	£ 502,491
OM2	20% most	£ -	45.0		£ -
	21-40%	£ -	30.0		£ -
	Least 60%	£ 969,791	20.0		£ 193,958
OM3	20% most	£ -	45.0		£ -
	21-40%	£ -	30.0		£ -
	Least 60%	£ -	20.0		£ -
OM4		£ -	100.0		£ -
Total		£ 10,014,621			**£ 696,449**

Maximum for Outcomes delivered. The actual value any scheme is elligible for may be less.

Sensitivity Testing. *It is important that users of this calculator appreciate the implications on funding from changes to input data which may become necessary as the project develops and better information is available. Five typical tests are provided below. Users should consider how appropriate these are to their project, what other tests may be appropriate and how best to use the information with all those that may be involved in the project.*

	Raw Score	Contribution for 100% Score (£k)
As scenario above	75%	191,108
Sensitivity 1 - Change in PV Whole Life Cost (25% increase)	27%	705,009
Sensitivity 2 - Change in OM2 - 50% of households in Very Significant (Before) risk may already be in Significant Risk band	72%	218,683
Sensitivity 3 - Change in OM3 - 50% of households in Medium Term loss (Before) may already be in Long Term loss	75%	191,108
Sensitivity 4 - Increase Duration of Benefits by 25%	24%	587,292
Sensitivity 5 - Reduce Duration of Benefits by 25%	73%	211,870

END OF WORKSHEET

Gurnard to Cowes refurbishment*

FCRM Partnership Funding Calculator for Flood and Coastal Erosion Risk Management Grant in Aid (FCRM GiA)
Version 8 January 2014

Project Name WW Strategy - Gurnard to Cowes 20 year Refurbishment scheme (in 2030)
Unique Project Number

Key: Input cells / Calculated cells

All figures are in £'s
Figures in Blue to be entered onto Medium Term Plan

SUMMARY: prospect of FCRM GiA funding

Scheme Benefit to Cost Ratio:	5.86	to 1
Effective return to taxpayer:	5.86	to 1
Effective return on contributions:	n/a	to 1

Raw Partnership Funding Score	52%	(1)
External Contribution or saving required to achieve an Adjusted Score of 100%	1,345,677	(2)
Adjusted Partnership Funding Score (PF)	52%	(3)
PV FCERM GiA towards the up-front costs of this scheme (PV Cost for Approval)	-	(4)

Cell (2) shows the minimum amount of contributions and/or reductions in scheme cost that are required to raise the Adjusted PF Score to at least 100%. Further increases on this will improve this scheme's chances of an FCRM GiA allocation in the desired year. Planned savings and contributions should be entered into cells(9,10,12) and cells(14-17). See NOTE below.

1. Scheme details

Risk Management Authority type of asset maintainer	LA	(5)
Duration of Benefits (years)	20	(7)
PV Whole-Life Benefits:	17,804,829	(8)

Yes (6) — Is evidence available that a Strategic Approach has been taken, and that double counting of benefits has been avoided ?

All costs and benefits must be on a Present Value (PV) Whole-Life basis over the Duration of Benefits period. Where Contributions are identified these should also be on a Present Value basis.

PV Costs		
PV Appraisal Costs	100,000	(9)
PV design & Construction Costs	2,700,000	(10)
Sub Total - PV Cost for Approval (appraisal,design,construction)	2,800,000	(11)
PV Post-Construction Costs	239,770	(12)
PV Whole-Life Costs:	3,039,770	(13)

The total value of any necessary contributions will depend on whether maintenance (ongoing costs) is funded through revenue FCRM GiA, or by other means.

NOTE: This scheme is to be maintained by an RMA other than the EA (ref cell 5). Capital FCRM GiA will fund the appropriate share of the up-front costs (cell 11) with any shortfall needing to be paid for via contributions identified in cells(14-17). Future ongoing costs (cell 12) and any contriubutions towards them are a matter for local agreement by the RMA and should NOT be included in cells(14-17). It is recommended that the RMA takes the opportunities created during scheme development to separately secure contributions towards future ongoing costs (cell12).

PV Contributions secured to date		
PV Local Levy secured to date		(14)
PV Public Contributions secured to date		(15)
PV Private Contributions secured to date		(16)
PV Funding form other Environment Agency functions/sources secured to date		(17)
PV Total Contributions secured to date	0	(18)

WARNING: Contributions less than minimum required in cell (2)

2. Qualifying benefits under Outcome Measure 2: households better protected against flood risk

Number of households in:	Before			After			Change due to scheme		
20% most deprived areas				-	-	-	0	0	0
21-40% most deprived areas				-	-	-	0	0	0
60% least deprived areas	-			-	-	-	0	0	0
At:	Moderate risk	Significant risk	Very significant risk	Moderate risk	Significant risk	Very significant risk	Moderate risk	Significant risk	Very significant risk
Annual damages avoided (£), compared with a household at low risk							150	600	1,350

Change in household damages, in:	Per year	Over lifetime of scheme	Qual. benefits (discounted)	
20% most deprived areas	£ -	£ -	OM2 (20%)	£ -
21-40% most deprived areas	£ -	£ -	OM2 (21-40%)	£ -
60% least deprived areas	£ -	£ -	OM2 (60%)	£ -

3. Qualifying benefits under Outcome Measure 3: households better protected against coastal erosion

Number of households in:	Before		Damages per household avoided:			
20% most deprived areas			Annual damages avoided	£ 6,000	£ 6,000	
21-40% most deprived areas			Loss expected in	50	20	years
60% least deprived areas	-	89	Present value of Year 1 loss (i.e. first year damages, discounted based on when loss is expected)	£ 1,184	£ 3,015	
	Long-term loss	Medium-term loss		Long-term loss	Medium-term loss	

Change in household damages, in:	Year 1 loss avoided:	Over lifetime of scheme:	Qual. benefits (discounted):	
20% most deprived areas	£ -	£ -	OM3 (20%)	£ -
21-40% most deprived areas	£ -	£ -	OM3 (21-40%)	£ -
60% least deprived areas	-£ 268,370	-£ 5,367,404	OM3 (60%)	£ 4,082,555

4. Qualifying benefits under Outcome Measure 4: statutory environmental obligations met

Payments under:			Assumed benefits per unit:	Qual. benefits (discounted):	
OM4a		Hectares of net water-dependent habitat created	£ 15,000	OM4a	£ -
OM4b		Hectares of net intertidal habitat created	£ 50,000	OM4b	£ -
OM4c		Kilometres of protected river improved	£ 80,000	OM4c	£ -
				OM4	£ -

5. Qualifying benefits arising from the overall scheme, for entry into the Medium-Term Plan

OM, deprivation:		Qual. benefits:	Payment rate:		FCRM GiA contribution:
OM1		£ 13,722,273	5.56	p in the £1	£ 762,349
OM2	20% most	£ -	45.0		£ -
	21-40%	£ -	30.0		£ -
	Least 60%	£ -	20.0		£ -
OM3	20% most	£ -	45.0		£ -
	21-40%	£ -	30.0		£ -
	Least 60%	£ 4,082,555	20.0		£ 816,511
OM4		£ -	100.0		£ -
Total		£ 17,804,829			£ 1,578,860

Maximum for Outcomes delivered. The actual value any scheme is elligible for may be less.

Sensitivity Testing. *It is important that users of this calculator appreciate the implications on funding from changes to input data which may become necessary as the project develops and better information is available. Five typical tests are provided below. Users should consider how appropriate these are to their project, what other tests may be appropriate and how best to use the information with all those that may be involved in the project.*

	Raw Score	Contribution for 100% Score (£k)
As scenario above	52%	1,345,677
Sensitivity 1 - Change in PV Whole Life Cost (25% increase)	19%	2,845,555
Sensitivity 2 - Change in OM2 - 50% of households in Very Significant (Before) risk may already be in Significant Risk band	52%	1,345,677
Sensitivity 3 - Change in OM3 - 50% of households in Medium Term loss (Before) may already be in Long Term loss	#VALUE!	#VALUE!
Sensitivity 4 - Increase Duration of Benefits by 25%	31%	1,935,708
Sensitivity 5 - Reduce Duration of Benefits by 25%	49%	1,441,907

END OF WORKSHEET

*scheme assessed assuming it will begin in epoch 2 rather than present day

Bouldnor Road Refurbishment*

FCRM Partnership Funding Calculator for Flood and Coastal Erosion Risk Management Grant in Aid (FCRM GiA)
Version 8 January 2014

Project Name	WW Strategy - Bouldnor Road 20 year scheme in 2025
Unique Project Number	

Key: Input cells / Calculated cells

All figures are in £'s
Figures in Blue to be entered onto Medium Term Plan

SUMMARY: prospect of FCRM GiA funding

		Scheme Benefit to Cost Ratio:	13.48 to 1
		Effective return to taxpayer:	13.48 to 1
Raw Partnership Funding Score	75% (1)	*Effective return on contributions:*	n/a to 1
External Contribution or saving required to achieve an Adjusted Score of 100%	291,018 (2)		
Adjusted Partnership Funding Score (PF)	75% (3)		
PV FCERM GiA towards the up-front costs of this scheme (PV Cost for Approval)	- (4)		

Cell (2) shows the minimum amount of contributions and/or reductions in scheme cost that are required to raise the Adjusted PF Score to at least 100%. Further increases on this will improve this scheme's chances of an FCRM GiA allocation in the desired year. Planned savings and contributions should be entered into cells(9,10,12) and cells(14-17). See NOTE below.

1. Scheme details

Risk Management Authority type of asset maintainer	LA (5)	Yes (6)
Duration of Benefits (years)	20 (7)	
PV Whole-Life Benefits:	16,671,069 (8)	

Is evidence available that a Strategic Approach has been taken, and that double counting of benefits has been avoided ?

All costs and benefits must be on a Present Value (PV) Whole-Life basis over the Duration of Benefits period. Where Contributions are identified these should also be on a Present Value basis.

PV Costs	
PV Appraisal Costs	25,000 (9)
PV design & Construction Costs	1,134,000 (10)
Sub Total - PV Cost for Approval (appraisal,design,construction)	**1,159,000** (11)
PV Post-Construction Costs	77,697 (12)
PV Whole-Life Costs:	1,236,697 (13)

The total value of any necessary contributions will depend on whether maintenance (ongoing costs) is funded through revenue FCRM GiA, or by other means.

NOTE: This scheme is to be maintained by an RMA other than the EA (ref cell 5). Capital FCRM GiA will fund the appropriate share of the up-front costs (cell 11) with any shortfall needing to be paid for via contributions identified in cells(14-17). Future ongoing costs (cell 12) and any contriubutions towards them are a matter for local agreement by the RMA and should NOT be included in cells(14-17). It is recommended that the RMA takes the opportunities created during scheme development to separately secure contributions towards future ongoing costs (cell12).

PV Contributions secured to date		
PV Local Levy secured to date		(14)
PV Public Contributions secured to date		(15)
PV Private Contributions secured to date		(16)
PV Funding form other Environment Agency functions/sources secured to date		(17)
PV Total Contributions secured to date	0	(18)

WARNING: Contributions less than minimum required in cell (2)

2. Qualifying benefits under Outcome Measure 2: households better protected against flood risk

Number of households in:	Before			After			Change due to scheme		
20% most deprived areas				-	-	-	0	0	0
21-40% most deprived areas				-	-	-	0	0	0
60% least deprived areas	-			-	-	-	0	0	0
At:	Moderate risk	Significant risk	Very significant risk	Moderate risk	Significant risk	Very significant risk	Moderate risk	Significant risk	Very significant risk
Annual damages avoided (£), compared with a household at low risk							150	600	1,350

Change in household damages, in:	Per year	Over lifetime of scheme	Qual. benefits (discounted)	
20% most deprived areas	£ -	£ -	OM2 (20%)	£ -
21-40% most deprived areas	£ -	£ -	OM2 (21-40%)	£ -
60% least deprived areas	£ -	£ -	OM2 (60%)	£ -

3. Qualifying benefits under Outcome Measure 3: households better protected against coastal erosion

Number of households in:	Before		Damages per household avoided:			
20% most deprived areas			Annual damages avoided	£ 6,000	£ 6,000	
21-40% most deprived areas			Loss expected in	50	20	years
60% least deprived areas			Present value of Year 1 loss (i.e. first year damages, discounted based on when loss is expected)	£ 1,184	£ 3,015	
	Long-term loss	Medium-term loss		Long-term loss	Medium-term loss	

Change in household damages, in:	Year 1 loss avoided:	Over lifetime of scheme:	Qual. benefits (discounted):	
20% most deprived areas	£ -	£ -	OM3 (20%)	£ -
21-40% most deprived areas	£ -	£ -	OM3 (21-40%)	£ -
60% least deprived areas	£ -	£ -	OM3 (60%)	£ -

4. Qualifying benefits under Outcome Measure 4: statutory environmental obligations met

Payments under:			Assumed benefits per unit:	Qual. benefits (discounted):	
OM4a		Hectares of net water-dependent habitat created	£ 15,000	OM4a	£ -
OM4b		Hectares of net intertidal habitat created	£ 50,000	OM4b	£ -
OM4c		Kilometres of protected river improved	£ 80,000	OM4c	£ -
				OM4	£ -

5. Qualifying benefits arising from the overall scheme, for entry into the Medium-Term Plan

OM, deprivation:		Qual. benefits:		Payment rate:	FCRM GiA contribution:	
OM1		£	16,671,069	5.56 p in the £1	£	926,170
OM2	20% most	£	-	45.0	£	-
	21-40%	£	-	30.0	£	-
	Least 60%	£	-	20.0	£	-
OM3	20% most	£	-	45.0	£	-
	21-40%	£	-	30.0	£	-
	Least 60%	£	-	20.0	£	-
OM4		£	-	100.0	£	-
Total		£	16,671,069		£	**926,170**

Maximum for Outcomes delivered. The actual value any scheme is elligible for may be less.

Sensitivity Testing. *It is important that users of this calculator appreciate the implications on funding from changes to input data which may become necessary as the project develops and better information is available. Five typical tests are provided below. Users should consider how appropriate these are to their project, what other tests may be appropriate and how best to use the information with all those that may be involved in the project.*

	Raw Score	Contribution for 100% Score (£k)
As scenario above	75%	291,018
Sensitivity 1 - Change in PV Whole Life Cost (25% increase)	27%	1,058,158
Sensitivity 2 - Change in OM2 - 50% of households in Very Significant (Before) risk may already be in Significant Risk band	75%	291,018
Sensitivity 3 - Change in OM3 - 50% of households in Medium Term loss (Before) may already be in Long Term loss	75%	291,018
Sensitivity 4 - Increase Duration of Benefits by 25%	0%	1,159,000
Sensitivity 5 - Reduce Duration of Benefits by 25%	75%	291,018

END OF WORKSHEET

*scheme assessed assuming it will begin in epoch 2 rather than present day